A

PRACTICAL ESSAY

ON

NECROSIS.

Serfojee Rajah · 1827

A

PRACTICAL ESSAY

ON A CERTAIN

DISEASE OF THE BONES,

TERMED

NECROSIS.

ILLUSTRATED WITH SIX PLATES.

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AN

AN ESSAY ON NECROSIS.

SECTION I.

General Remarks, and Description of Appearances.

THE power of reproduction which nature possesses, displays itself in a great variety of morbid cases, but in none of them more remarkably than in a certain disease of the bones, termed *Necrosis* *.

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* The import of the term *Necrosis*, is more fully considered in the explanation which is annexed to the plates. So that, if any difficulty or ambiguity arises from the want of a particular definition of the term, it will be of advantage to consult the explanation of the plates, previous to the perusal of the Essay.

In this diſeaſe new parts are formed in a very curious manner, and with a degree of perfection altogether extraordinary. For after the entire loſs of the original bone, the formation of a ſubſtitute one enables the patient to perform all the uſual functions of the limb, without any ſenſible inconvenience or difficulty; and it is a very remarkable circumſtance, that, in favourable inſtances of the diſeaſe, the power of motion is preſerved during all the time theſe changes are going on. Conſequently the new bone muſt have begun to grow, and muſt have acquired firmneſs, before the old bone ſeparates and comes away, elſe there muſt be an interval of time at which the power of motion would be entirely ſuſpended. Since it is plain that if the original bone were to ſeparate

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while the incipient ſubſtitute was ſtill ſoft and flexible, the limb could perform no motion which required the aſſiſtance of a ſolid ſupport, and would therefore be completely uſeleſs.

In this reſpect, then, a caſe of Necroſis differs from all other caſes of renovation, ſince in every one of them the newly formed parts begin from the firſt to fill up the exact ſpace which the original parts before occupied, and which had previouſly been left empty by their deſtruction or removal.

Theſe leading facts explain many important circumſtances in the hiſtory of the diſeaſe.

First, The new bone muſt be formed and conſolidated before the old one ſeparates, otherwiſe (as has already been obſerved) the patient could not continue to uſe his limb during all the time of the cure; as it muſt become flexible and uſeleſs the moment the old bone ſeparated, unleſs a new one had been previouſly formed to ſerve the ſame purpoſes.

Secondly, Another conſequence of the formation of the new bone anticipating the ſeparation of the old, is that the new bone ſhould ſurround and include the old one. For ſince the lifeleſs portion of bone completely occupies the ſpace between the two living extremities, it is impoſſible for the newly formed bone to connect the extremities directly. The connection can alone be completed by the

the new bone paſſing over the old bone from the one end to the other, and attaching itſelf to the portions which ſtill remain alive; and this actually is the courſe which nature follows in a caſe of Necroſis.

Thirdly, It is a plain inference from the laſt deduction, that the new bone muſt be larger than the old one; for the new bone is formed upon the outſide of the old bone, conſequently even the internal dimenſions of the new bone muſt exceed the external dimenſions of the old one; ſo that its outſide meaſure will be much greater. Upon this account, the affected limb will, after the cure is complete, be larger, clumſier, and leſs ſhapely than the other limb; but the length of it remains unaltered, becauſe

the old bone retains its attachments, while the rudiments of the new bone are lying on the outſide of it, and connecting the extremities of the old bone by a rigid maſs equal in length to the portion which was removed or deſtroyed.

We may therefore conſider the four following circumſtances to be fully eſtabliſhed in caſes of Necroſis.

That the new bone is formed and conſolidated before the old bone ſeparates; that it ſurrounds the old bone, and is larger in ſize, but equal in length.

The facts aſcertained by the above induction ſerve farther to explain the proceſs which nature follows in the formation of the new oſſeous ſhell. The old

bone

bone ſerves as a mould for the new one. And the firſt ſtep of the proceſs is to ſurround the old bone with an effuſion, which ſeems to be of gelatinous nature.

This effuſion is more denſe as it approaches to the ſurface of the old bone, and more rare as it recedes from it. The thickneſs of the ſtratum is variable, but it always is conſiderable, and in certain caſes it appears to exceed an inch. For in ſome inſtances the new oſſeous ſhell has been found an inch thick, after the oſſification is complete, ſo that the thickneſs of the original effuſion muſt be greater than this, as the whole of the maſs never is entirely converted into bone. And indeed before any bone begins to form, this effuſed ſtratum acquires an additional degree of conſiſtence. After

theſe oſſific nuclei make their appearance in different places, and quite diſtinct from each other, they increaſe in number, and enlarge in ſize, till at laſt they come into contact, and unite together, ſo that the whole of the effuſed ſtratum is converted into a maſs of bone. The earlieſt date of the appearance of theſe nuclei in the human ſubject, is (ſo far as I know) twenty-four days from the original commencement of the attack. But for ſome months after a ſtratum of ſolid bone has been formed, additional nuclei are occaſionally forming, attaching themſelves to the oſſified ſtratum, and thus making a gradual addition to the bulk of the general maſs of bone.

The proceſs proceeds in this manner, until the oſſification extends completely

along

along the whole length of the original depoſition, and around the whole of its circumference. The new bone which forms, is perfectly hard, and completely organized, but not diſpoſed into the ſame regular lamellæ with the primitive bone. It is likewiſe capable of aſſuming all the actions competent to a bone of the moſt regular and perfect ſtructure. If any part of it meets with an injury which deprives it of life, the dead portion then ſeparates from the living, by the proceſs of exfoliation *. It is alſo capable of giving birth to oſſific granulations *, which are at laſt converted into ſolid bone. So that it appears to poſſeſs all the properties of a bone in the moſt perfect ſtate of health and vigour.

From

* See Plate IV. with explanation.

From the account given of the manner in which this new bone forms, it is evident that the tendons of the muſcles muſt retain their relative poſitions with reſpect to each other, and be inſerted into points in the new bone, correſponding to their original inſertions into the old bone. Becauſe, at the time of the primary effuſion, all the tendons lie in their natural and relative places; and in this ſtate they are ſurrounded and fixed by the gradual conſolidation and ultimate converſion of the effuſion into ſolid bone. And thus it is eaſy to comprehend the way in which the inſertion of the muſcles is transferred from the old bone to the new one.

The manner in which the tendons diſengage themſelves from the old bone, is equally

equally eafily conceived. The tendons are in a living and healthy ftate, and confequently incapable of continuing united with parts which are dead. They muft neceffarily, therefore, feparate from the old bone, when it dies. And as they are previoufly attached to the nafcent bone, no derangement refults from the feparation; which is effected without violence.

The dead portion of the old bone, which feparates from the living portions, is diftinguifhed by the appropriated name of *Sequeftra*, and is a part which makes a confpicuous figure in the future management of the cafe.

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SECTION II.

Origin of the New Parts.

AFTER explaining the hiftory of a cafe of Necrofis, we are naturally led to enquire into the origin of this new offeous fhell, and into the circumftances which occafion its formation.

The origin of this new offeous fhell was firft, and indeed has generally been imputed to the enlargement and offification of the periofteum of the old bone. This conjecture was eafily grafted upon Mr Du HAMEL's opinion, that all bones were originally produced, and owed their growth to the furrounding periofteum.

How

How far Mr Du Hamel's opinion is well founded, and, in what particulars it fails, it is not now neceſſary to enquire: But upon this foundation the growth of the oſſeous ſhell has been imputed ſolely to the extenſion of the perioſteum, and to the depoſition of oſſeous particles in the heart of its ſubſtance, or between its layers.

According to this latter ſuppoſition, that the bony matter is depoſited between the layers of the perioſteum, the new oſſeous ſhell ſhould derive a complete covering from the original perioſteum, both on its inner and its outer ſurface. That this, however, is not the fact, appears from an examination of parts while they are forming. It is then evident that oſſific granulations ariſe both from

from the internal and external ſurface of the new oſſeous ſhell, but on neither of the ſurfaces does the ſmalleſt veſtige of a covering derived from the original perioſteum make its appearance. Indeed, this idea ſeems to me wholly incompatible with the inequalities of both ſurfaces. For, if two layers of perioſteum were diſtended by the interpoſition of oſſific matter between them, both ſurfaces would then be ſmooth along the whole of their extent. Yet, that the direct contrary takes place, is apparent from the ſlighteſt examination of appearances. Beſides, in thoſe caſes, where the ſequeſtra is removed, and conſequently does not limit the extenſion of the new bone internally, the whole ſpace fills up, and the cavity is totally obliterated along with the ſuppoſed inveſting perioſteum. Yet, ſurely, this oblitera-

tion could not poſſibly happen, if the internal ſurface of the new bone were fortified with a lining from the original perioſteum.

And further, in all caſes of Necroſis, the new bone in its incipient ſtate is on its outſide ſo blended with the neighbouring parts, that it is impoſſible to diſtinguiſh and ſeparate them from each other; whereas if the new bone ſtill remained encompaſſed on its outſide with the external layer of the original perioſteum, the ſeparation of parts would be diſtinct and eaſy. Indeed, the want of this diſtinctneſs is almoſt of itſelf a proof that no covering is derived from the original perioſteum. Beſides, the ſuppoſed ſwelling and ſubſequent oſſification of the perioſteum has never yet been eſtabliſhed by any regular ſeries of accurate

obſervations. And even according to this objectionable explanation of appearances, the proceſs by which the new bone is generated and formed is wholly different from the ordinary proceſs of oſſification. The formation, then, of this new bone is at leaſt an extraordinary effort of nature, to repair an accidental loſs. And whether the reparation be accompliſhed by the perioſteum, or by any other ſet of parts, the proceſs is equally removed from the uſual operations of the animal œconomy. To me, however, it ſeems proved almoſt to a demonſtration, that the original perioſteum has no ſhare whatever in the formation of the new bone. I found my opinion upon the following conſiderations:

This

This new ſhell forms under circumſtances where it is impoſſible that the original perioſteum can have any ſhare in promoting the proceſs. There are certain caſes of compound fracture *, in which the cure is accompliſhed by the formation of an oſſeous ſhell, exactly ſimilar in all reſpects to the oſſeous ſhells which form in the common caſes of Necroſis.

It is undoubtedly formed upon the ſame principles, and ſerves to unite the living extremities together, independently of any connection with the intermediate fractured portion. The caſe admits

* See Plate VI. with explanation. It is particularly neceſſary to conſult the plate, ſince, without it, the deſcription will not be ſo eaſily followed.

of ſome varieties, but all of them are equally repugnant to the ſuppoſition of the perioſteum being inſtrumental in producing the new growth of bone.

In the one caſe the ends of the broken bone overlap each other, and from the manner in which they are entangled, it is impoſſible to diſengage them; ſo that they muſt remain in this poſition during all the time of the cure. Yet even then the whole of the fractured portion is included in an oſſeous ſhell, although it be evident that in ſome part of the ſpace at leaſt, the perioſteum of the old bone, can have no ſhare in forming it *. Becauſe at the place where the extremities overlap, one end of the bone on one ſide, and

* This will be better underſtood by conſulting Plate VI. with the explanation.

and the other portion on the other, muſt be diſtant from the ſhell, equal to its diameter. The portion of the oſſeous ſhell, therefore, which forms over this vacant ſpace, cannot poſſibly derive its origin from any connection with the periosteum. And indeed, in ſuch caſes, a ſtratum of the oſſific effuſion, which connects the living extremities, is in general depoſited at a conſiderable diſtance from the intermediate portion which is fractured, and overlaps. So that, in this caſe at leaſt, no one can entertain a doubt that the new oſſeous ſhell forms quite independently of the perioſteum.

In the other caſe, the extremities of the bones do not indeed overlap, and the limb may be extended to its natural length, and placed in any poſition which

the ſurgeon chooſes. But this great mobility proceeds from the violence of the injury which the bone has ſuſtained. For, in very ſevere caſes, the fractured portion is ſhattered into a number of fragments, which have no connection either with one another, or with the unbroken portions. In theſe fragments too the perioſteum is completely torn and ſeparated from the entire bone; ſo that it could not poſſibly have been uſeful in forming a continuous ſhell, even ſuppoſing it to have continued alive. While the probability is, that from want of connection with living parts, its own life, and the life of the fragments to which it belongs, will be totally deſtroyed. Thus, ſo far from contributing to the formation of new parts, which had no exiſtence before, this inſulated perioſteum will

will not even be able to preferve its own place in the fyftem. In fuch cafes, therefore, it feems quite prepofterous to afcribe any fhare in the production of the new offeous fhell, to the action of a detached, and probably a lifelefs portion of periofteum.

There is ftill another cafe in point, fimilar to the laft, though feemingly more conclufive. In the cafe alluded to, a confiderable portion of bone, along with its proper periofteum, is torn away by violence. Confequently a vacuity is left. Yet even this vacuity becomes completely filled up with offeous matter, independently of the periofteum which had been torn away. I have known a cafe in which a large portion of the angle of the lower jaw was broken off by the

kick of a horſe's foot, and the loſs ſupplied by a new growth. The patient, a bridegroom, was able to fulfil his marriage engagements a few months after the accident. And the perioſteum having originally been torn away, could not poſſibly have any ſhare in reproducing the bone. Though no one can believe that this inſtance of reproduction was not accompliſhed on the common principle of a Necroſis.

A confirmation of the ſame doctrine may be found in one very ſingular caſe of ſimple fracture. The cure proceeded without any difficulty or any apparent ſingularity, only that immediately over the place of the fracture there was an uncommon thickneſs of parts. This thickneſs, however, occaſioned no pain nor

inconvenience,

inconvenience. But upon examining the parts by diſſection, it then appeared after how curious a manner the union of the fracture had been accompliſhed. For, contrary to the ordinary courſe of things, the extremities of the bones were not in contact, and the ſpace between them was empty, but the connection was completed by means of an oſſeous ring, which extended from the circumference of the one to the circumference of the other, and bound them firmly together. This ring, it is evident, could not originate from the perioſteum, ſince there was no perioſteum at the place where it formed. But the truth is, that it originated in the ſame manner, and the caſe in every reſpect correſponded with thoſe caſes of compound fracture in which the cure is conducted upon the principle of a Ne-

 croſis.

crosis. The instance referred to happened in the person of a child, and the interval between the ends of the bone, was an eight of an inch.

An opportunity likewise occurred to me of observing the progress of a case in which, notwithstanding the total destruction of the original bone and its periosteum, a new bone formed in their place *. The patient was a middle aged man, who suffered an attack of paronychia in the middle phalanx of the ring finger.

* Mr James Clark, Fellow of the Royal College of Surgeons, an intelligent and attentive practitioner, favoured me with an opportunity of examining this curious and instructive case. And as the patient put himself under Mr Clark's care from the commencement of the complaint, I can implicitly rely on the accuracy of every circumstance.

finger. In the courſe of the cure, the whole bone and perioſteum were taken away, and the finger was afterwards kept extended upon a ſmall ſplint. After this the cure proceeded without any interruption, and was at laſt completed by the formation of a maſs of bony matter which extended from the firſt to the third phalanx, and united them firmly together in one continuous bone. No new articulations were formed, ſo that this bone remained quite rigid, and conſequently the finger inflexible. It was of the ſame length with the correſponding finger of the other hand; but conſiderably thicker at the middle part, which was compoſed of the new growth of bone. The deſtruction of the perioſteum by diſeaſe, was in this caſe more obvious than uſual, from the

expoſure

expoſure of the whole parts to view, though I am perſuaded that the ſame change takes place in conſequence of the violent inflammation which accompanies every attack of Necroſis.

The whole of this doctrine derives additional confirmation from the reſult of ſome experiments which were made upon animals, for the expreſs purpoſe of aſcertaining this fact. In one experiment, the perioſteum was ſcraped off from the bone of the leg, yet notwithſtanding its removal, a new oſſeous maſs was formed, with all the appearances which uſually attend the renovation of bone, and in all the perfection of an ordinary caſe of Necroſis. This fact alone is concluſive on the point. And when it is brought in addition to the number of facts which

have

have already been adduced upon the ſubject, it is impoſſible to entertain a doubt of the inefficiency of the perioſteum in the formation of the new bone, and that indeed the preſence of the periosteum does in no caſe ſeem neceſſary to its production.

Thus, from a due conſideration of every circumſtance, it appears that the pulpy maſs which extends from one portion of the bone to the other, and is itſelf at laſt converted into bone, is entirely a new creation, and has no dependence upon the original bone, or its perioſteum. Yet, from whatever part it derives its origin, it ſerves the purpoſe of a bed for the oſſific granulations to ſhoot from. There is no neceſſity that it ſhould originally have any connection with the bone

bone or its membranes, ſince parts of a nature wholly different from bone are known to oſſify in a great variety of morbid caſes. Of this nature are the tendons, which very frequently are converted into bone. The blood-veſſels alſo, eſpecially the arteries, often ſuffer from oſſification. It is likewiſe a well known fact, that ſmall hard bony concretions are ſometimes found in the heart of cancerous tumours. I have a ſpecimen of this kind, in which a large portion of the cancerous tumour was converted into ſolid bone. Even the fat, of all parts of the body the moſt diſſimilar to the nature of bone, is capable of being oſſified. I have in my poſſeſſion a portion of a common ſteatomatous tumour, in the centre of which there is a very complete and diſtinct oſſification, about the

ſize

ſize of an ordinary pea. Thus, almoſt every part of the body ſeems capable of being converted into bone, by the operation of diſeaſe. So that the formation of bone in parts which originally were quite of a different nature, is not ſo extraordinary a fact in the human body. And as every conſideration leads one to conclude, that the formation of the oſſeous ſhell, in caſes of Necroſis, is independent of the perioſteum, it is fortunate that nature poſſeſſes the power of replacing the ſequeſtra, by means of a proceſs not altogether ſo foreign to the actions of the ſyſtem.

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SECTION III.

Causes which occasion the Formation of New Parts.

The next question to be considered is, What circumstances in the state of parts give occasion to the formation of this new osseous shell; and whether it be in the power of art to insure the establishment of so salutary a process, whenever it would be advantageous for the patient? One circumstance is obvious, and constantly precedes or accompanies the formation of the new bone. Inflammation, more or less violent, attacks all the parts which are to be the seat of the new bone, previously to every instance of renovation.

tion. And it has been thought, that the death of the primitive bone muſt neceſſarily precede the commencement of any proceſs to ſupply the loſs of it. Some ſymptoms, indeed, which appear in the courſe of the diſeaſe, very much countenance this opinion. Since ſome time or other, in the progreſs of every caſe of Necroſis, a portion of the primitive bone ſeems to be entirely deprived of life, and to detach itſelf from the ſyſtem; it was therefore very natural to ſuppoſe, that the death of the primitive bone muſt neceſſarily precede the commencement of any proceſs for the reparation of the loſs. This idea too, derived ſtrong confirmation from the reſult of ſome curious and intereſting experiments which Mr TROYA inſtituted, in order to aſcertain the truth of the fact. By introducing a ſharp inſtrument

ſtrument into the medullary canal, and deſtroying the whole of the marrow, he contrived to deprive the bone of its life, without injuring the external perioſteum, or the ſurrounding ſoft parts. And the reſult of the experiment was, that whenever the animal ſurvived the ſeverity of the operation, an entirely new oſſeous ſhell formed round the whole of the bone which was dead. Thus, he produced a number of artificial inſtances of the diſeaſe in queſtion. In all of the experiments, the firſt ſtep was to kill the original bone, ſo that the death of it, and the deſtruction of the marrow, neceſſarily preceded the commencement of any other proceſs. And ſince theſe caſes of natural and of artificial Necroſis were exactly ſimilar in their ultimate ſtate, the exactneſs of their final ſimilarity

naturally

naturally led to the concluſion that they agreed perfectly in all other reſpects, and aroſe from the ſame cauſes.

This opinion too, was the more probable, as in moſt caſes of natural Necroſis, the ſequeſtra is found dead, and the whole of its marrow gone. In the advanced ſtages of the complaint, the fact is conſtantly ſo. And as no circumſtances of diſagreement appeared in the caſes under review, and as the deſtruction of the marrow and death of the original bone never failed to give birth to the formation of a new bone, the concluſion in favour of the ſimilarity of the caſes in other reſpects was not altogether unjuſtifiable. The death of the bone and deſtruction of the marrow is doubtleſs one never failing cauſe of Necroſis. But

it does not thence follow, that no other train of circumſtances are capable of producing ſimilar effects. Indeed, I much queſtion whether the death of the bone and deſtruction of the marrow be the ſole cauſe of Necroſis, and always neceſſary to its production. Several conſiderations induce me to doubt the truth of the doctrine. It is a well known fact, that the moment any part of the body is wholly deprived of life, it ſeparates from the contiguous living parts; and in moſt caſes, the time requiſite to complete the ſeparation is not great. In a caſe of Necroſis, therefore, if the old bone muſt neceſſarily be dead before the formation of the new one commences, it would be impoſſible for the patient to preſerve the power of walking, during the whole of the time he was under the preſſure of the

diſeaſe;

diſeaſe; becauſe the ſequeſtra, ſo ſoon as it was dead, would begin to ſeparate from the old bone, and would completely leave its place, before any proviſion was made to repair the loſs by the formation of a ſubſtitute. Thus, the limb would be deprived of all ſupport from the old bone, without acquiring any ſtability from the ſubſtitution of a new one. So that in every caſe an interval muſt intervene between the ſeparation of the ſequeſtra and the conſolidation of the ſubſtitute, during which the power of walking would be completely ſuſpended. Accordingly, when the ſequeſtra comes away prematurely, and while the rudiments of the ſubſtitute is ſtill in a ſoft ſtate, the limb is flexible and uſeleſs from the ſoftneſs of the new bone, and requires the aſſiſtance of ſome rigid exter-

nal ſupport to retain it in a ſtraight poſition, and prevent it from bending. A like ſuſpenſion of the power of motion, and a temporary flexibility of the limb, would alſo occur in every caſe of Necroſis, unleſs the new bone was fully conſolidated previouſly to the final ſeparation of the ſequeſtra, and conſequently unleſs it had begun to form before the ſequeſtra was completely dead. It therefore ſeems probable, that the incipient formation of the ſubſtitute is prior to the death of the ſequeſtra, and may originate from other cauſes. In proof of this opinion, we meet with inſtances of Necroſis, in which the marrow of the ſequeſtra was entire and healthy at the time of its ſeparation, many months after the commencement of the attack, and even poſterior to the conſolidation of the ſubſti-

tute.

tute. I likewiſe poſſeſs a preparation of an incipient caſe of Necroſis, which illuſtrates this point in the cleareſt poſſible manner*. In this preparation one plainly perceives the ſequeſtra in the act of ſeparating from the extremities of the bone which are to remain, and that it ſtill preſerves its life, and is full of blood-veſſels; and theſe blood-veſſels have a direct communication with the arterial trunks which ſupply the reſt of the limb, ſince a quantity of injection readily paſſed into the ſubſtance of the ſequeſtra, and pervaded every part of it. In thoſe appearances there is no indication even of approaching death in that portion of bone which is deſtined to become the ſequeſtra, and which ſoon would have ſeparated from the reſt.

 Then

* See Plate III. with explanation.

Then as to the ſtate of parts which ſurround the ſequeſtra, and which ultimately were to oſſify and ſupply its place, there is a ſtratum of oſſific matter extending along the courſe of the ſequeſtra, including it, and connecting the permanent extremities of the bone together. This ſtratum, which is of conſiderable thickneſs, is the bed of future oſſifications, and in one place an oſſific nucleus had begun to form, and may be diſtinctly ſeen. And from the rapid progreſs of its formation, it ſeems probable that the oſſification of the ſubſtitute would have been complete, or at leaſt far advanced before the death and ſeparation of the ſequeſtra. Independently, too, of what the probable conſequences would have been, if the progreſs of the cure had not been ſtopped by the amputation of the

limb,

limb, the actual ſtate of parts preſented to view, affords the cleareſt evidence that the ſubſtitute bone begins to form long before the original one dies. To conſider then the previous death of the ſequeſtra, as the only exciting cauſe of Necroſis, is to adopt far too limited a view of the ſubject; for both the caſes which I have deſcribed, tend to prove, that the ſubſtitute bone may be far advanced in its formation before the ſequeſtra dies, and the marrow be deſtroyed. It therefore appears certain, that the previous death of the ſequeſtra is not indiſpenſible to the production of the incipient ſtates of Necroſis.

Indeed the truth ſeems to be, that no evident ſymptom invariably precedes the natural Necroſis of a bone, excepting an

attack of inflammation. But inflammation conſtantly precedes the formation of new parts. And the probability is, that the effects of the inflammatory attack have a double operation, and are the ſource, both of the death of the old bone, and of that ſtate of action, which gives birth to the generation of the ſubſtitute. The foundation of both proceſſes, the one terminating in death, and the other in reproduction, would therefore ſeem to be laid at the ſame time, and to depend upon one common cauſe. They are cotemporary in their commencement; and the formation of the ſubſtitute bone is the offspring of the ſame attack of inflammation, which kills the ſequeſtra, and not the conſequence of its death. In that caſe of paronychia, too, in which the bone and its perioſteum were completely

pletely removed from the finger, a perfect fubftitute bone was formed, although the commencement of the reproduction was pofterior to the removal of the original parts, fo that the prefence of a dead fequeftra could not poffibly have a fhare in promoting it.

In this inftance, at leaft, the exciting caufe of the reproduction muft have been very different from any ftimulus which it was in the power of the original parts to communicate.

Upon the whole, then, this conclufion is manifeft, that although the death of a bone, from the deftruction of the marrow, may be one caufe of producing an attack of Necrofis ; yet, that this circumftance

cumſtance alone is not the ſole and indiſpenſible cauſe of its production.

Inflammation always precedes Necroſis; and many different cauſes excite that kind of inflammation, which terminates in Necroſis. For it is not every attack of inflammation, but only thoſe of a peculiar or ſpecific nature, which have this termination. But as yet we are not acquainted with that peculiar ſtimulus, which, in the human body, has the power to excite ſuch an attack of inflammation, as will ultimately terminate in a caſe of artificial Necroſis. All ſuch caſes have hitherto been the creature of accident, ariſing at times when they were little expected, and owing no part of their origin to the interference of art. It would doubtleſs be moſt convenient to poſſeſs the

the means of calling forth ſo uſeful an effort of nature, when there is no proſpect of effecting a cure, unleſs ſome extraordinary exertion takes place. But as yet this is an expectation, which we cannot indulge with confidence, and muſt at preſent content ourſelves with the power of managing the caſes which naturally occur, in a manner the moſt advantageous to the patient.

SEC-

SECTION IV.

Particular Hiſtory of Symptoms.

In every caſe of Necroſis, a ſevere deep ſeated pain is the firſt ſymptom which appears.

This pain, at its commencement, is not aggravated by preſſure. But as the inflammation travels outwards, and acquires a more ſuperficial ſituation, the external parts become more ſenſible, till at laſt they acquire the ſenſibility of parts in a ſtate of high inflammation. Such is the progreſs of the pain.

At

At the outſet of the attack, no other ſymptom makes its appearance. Neither the ſize nor the ſhape of the limb undergoes any ſenſible change for ſome time. But ſo ſoon as a ſtratum of materials is laid for the depoſition of oſſeous matter, the limb becomes much enlarged along the whole courſe of the bone; and this enlargement occurs at an early period of the complaint, and ſoon attains its full ſize. Afterwards it continues ſtationary and unchangeable, both in ſize and ſhape. In the leg, which is a common ſeat of Necroſis, this enlargement may be diſtinctly traced by an external examination of the parts. It follows the courſe of the tibia, a bone in which Necroſis often occurs. Thus an incipient caſe of Necroſis is characteriſed by a deep ſeated excruciating pain, not at

firſt

firſt aggravated by preſſure, and which is ſoon followed by the rapid enlargement of the parts along the courſe of the bone. The degree of pain indeed is variable. Though whenever we find a deep ſeated pain accompanied with a, ſudden enlargement of the parts along the courſe of the bone, we have reaſon to ſuſpect the preſence of an incipient caſe of Necroſis.

Theſe ſymptoms, however, do not long remain ſtationary; but ſooner or later acquire an addition to their number. For, ſhortly after the commencement of the attack, an external inflammation ſucceeds, and this is ſoon followed by ſuppuration and a collection of matter, whch at laſt diſcharges itſelf externally by a ſmall opening. The extent

of

of this inflammation is not in general great. Though for the moſt part a number of ſimilar circumſcribed inflammations make their appearance about the ſame time. They all of them diſcharge matter externally through ſmall openings which do not cloſe, and by continuing open, and diſcharging matter, prove the origin of a number of fiſtulous ſores. In general, the fiſtulas which form in this way, lie in the moſt projecting line of the bone. In the leg, they are all ſituated on the anterior part where the bones are moſt thinly covered with ſoft parts.

Theſe ulcers are ſeldom provided with an extenſive ſurface *. The orifice is in general ſurrounded by a ſmall prominence, ſomewhat elevated above the level

* See Plate V. with explanation.

vel of the ſkin. The elevation of the prominence is commonly a quarter of an inch, and its diameter half an inch.

The matter which diſcharges from theſe fiſtulæ is almoſt uniformly of a good quality, neither offending in point of ſmell, colour, nor conſiſtence. In theſe reſpects it differs from the quality of the matter diſcharged from a diſeaſed bone, which is at all times exceedingly fœtid, and in general diſcoloured and thin.

In point of quantity, the diſcharge of purulent matter is always very great, in proportion to the number and ſize of the external openings. Becauſe they are only the terminations of paſſages which conduct to an extenſive cavity. And in this

this circumſtance they perfectly agree with the common character of a narrow fiſtulous opening, that leads to a large internal collection of purulent matter. But, in other reſpects, the coincidence of ſymptoms is not ſo complete. For, in other caſes of purulent collections about the extremities of the body, the application of external preſſure increaſes the quantity of the diſcharge. In a caſe of Necroſis, however, it has no ſuch effect; and the reaſon of the difference is plain. In a common abſceſs of the cellular ſubſtance, however deeply ſeated, the effect of external preſſure is propagated through the ſoft parts, till it reaches the ſeat of the abſceſs, and expels the matter through the orifices. The ſoft nature of the parts admits of their yielding. But in a caſe of Necroſis, it is im-

poſſible they can yield in the leaſt; because the collection of matter is lodged within the cavity of the newly formed oſſeous ſhell, which is rigid and inflexible, and does not yield to preſſure. It is obvious then that the cavity admits of no diminution, and conſequently that the quantity of the diſcharge cannot increaſe by the application of preſſure to the external parts of the limb. For the ſame reaſon, it is evident that the moſt delicate touch can perceive no ſign of fluctuation, however obſcure, by the external examination of the parts. The firm ſhell of bone which contains the matter, prevents any motion from being felt. The diſcharge proceeds altogether from the inſide of the bone, which is the cauſe of the different appearances that take place.

Appearance

Appearance of the parts. The extremities of the fiſtulous openings are generally red, and well coloured on their ſurface; and though they continue long ſtationary, and ſhow little diſpoſition to heal, they rarely exhibit an unhealthy appearance, or become what is termed ill conditioned ulcers.

A probe introduced at the orifice of the fiſtula, ſeldom penetrates to any great depth, or diſcovers any looſe piece of bone. For, in this ſtage the ſequeſtra can very ſeldom be felt. Sometimes, indeed, ſmall ſpiculæ of bone paſs through the external openings, along with the purulent matter. Their appearance, however, is not conſtant; but whenever it happens, we are certain that the bone is at bottom concerned in ſup-

porting the diſeaſe. Theſe ſeparating ſpiculæ too are rarely felt looſe and moveable any time before their final ejection. They appear unexpectedly, without giving any previous intimation of their approach. The reaſon of which is, that they do not ſeparate from the external ſurface of the bone, but are portions of the ſequeſtra which is included within the cavity of the new oſſeous ſhell, and conſequently protected from the touch of the probe at the time of their ſeparation. No doubt ſome other deep ſeated exfoliations may exhibit ſomewhat of a ſimilar appearance; but, excepting in a caſe of Necroſis, no ſuch appearance can occur, when the bone lies ſuperficially.

The number of theſe ulcerations will be more or leſs great, and the diſcharge of matter more or leſs profuſe, and of longer or ſhorter duration, according to different circumſtances. But, in all caſes of Necroſis, they make their appearance at ſome period or other of the complaint *.

Even the preparation of the bones of thoſe caſes of Necroſis whoſe hiſtory is not known, ſhow plainly that ſuch fiſtulous openings muſt have exiſted during the pendency of the diſeaſe. It is indeed poſſible to conceive a caſe ſo mild in its ſymptoms, that it ſhall complete the ſubſtitution, without producing any ulceration externally; though, as yet, no

* See Plate I.

instance of so mild a case has ever occurred in practice.

The progress of all cases of Necrosis is nearly alike, till the appearance of these ulcerations. The symptoms may indeed be more or less violent, but in other respects they are similar. But, after this period, the appearances differ very much, according to the manner in which the case is to terminate. There are two very distinct terminations.

In the one, the mildest and most desirable termination, the ulcerations gradually heal up, without exhibiting any unusual appearance. The sequestra never is seen; and the patient, if he ever had lost the use of his limb, soon regains it, and is again enabled to walk with

eaſe and firmneſs. After this, no veſtige of the diſeaſe remains, excepting a permanent enlargement and induration along the courſe of the bone. So that no very ſingular ſymptom appears in the courſe of this termination.

In the other termination, which is leſs favourable, but attended with more curious and intereſting ſymptoms, the ſequeſtra makes a conſpicuous figure. It appears externally, by forcing a paſſage for itſelf through the new formed bone, and the common integuments. Sometimes it works its way out, without being preceded by any conſiderable ſuppuration or collection of matter. In this form of attack, the degree both of pain and inflammation is very moderate, and the bone often projects ſuddenly and un-

 expectedly,

expectedly, to the great surprise of the patient, but without giving him much uneasiness. The case, however, is different, when the protrusion of the bone is preceded by any considerable suppuration and collection of matter; for then the pain which the patient suffers, is often very great, and does not abate till after a natural or artificial opening of the abscess has removed the tension and irritation.

The extremity of the sequestra, at the time of its protrusion, is always rough, and in general exceedingly irregular and sharp. It may be moved by shaking, but is too firmly wedged in with the neighbouring parts, to allow of its complete extraction. In time, however, this firmness diminishes, and the se-

questra

queſtra gradually becomes looſer, partly in conſequence of the conſumption of a portion of its own ſubſtance, and partly from the waſting of the new formed oſſeous ſhell, by preſſure *. At laſt, however, from the conjoint operation of theſe two cauſes, the paſſage in general becomes wide enough to permit all that remains of the ſequeſtra to eſcape.

In other caſes of Necroſis, however, it is not the extremity of the ſequeſtra, but a part of the middle portion, which preſents itſelf upon the opening of the abſceſs †. The new ſhell of bone incloſes the ſequeſtra on every other ſide, and though it permits of motion upwards and downwards, in the direction of the cavity

* See Plate V. fig. 2, 3.

† See Plate V. fig. 1.

vity of the bone, yet it confines the sequestra too closely to permit of any lateral motion. Under these circumstances, the process for the ejection of the sequestra may go on very slowly, and unless some material change takes place in the position or destruction of the parts, they may remain unchanged for a great length of time. It is indeed difficult to say what would be the final result of such a case, if it were permitted to follow its own course; since the assistance of an operation is so highly necessary to complete the process, that the conclusion of the case is never left to the spontaneous efforts of nature. The interference of art being indispensible to complete, or at least to accelerate the cure. Thus the natural termination of this form of an attack of Necrosis, is still somewhat a matter of conjecture.

It is evident that, upon the final ejection of the ſequeſtra, the cavity of the new bone muſt be left empty, and free from every kind of irritation which the preſence of an extraneous body might produce. So that there is not in future any impediment to retard or interrupt the progreſs of the cure.

But before entering upon the diſcuſſion of this point, it will be neceſſary to recur to the conſideration of the ſtate of the internal cavity of the new oſſeous ſhell when the cure takes place, without the excluſion of the ſequeſtra. It is obvious, that the newly formed cavity muſt either be full or empty; and experience ſhows, that both conditions obtain. According, indeed, to the general account of

of Necrosis, given at the beginning of this paper, the sequestra was supposed always to remain included within the cavity of the new shell, because this supposition afforded the simplest view of the disease. The complete inclusion of the sequestra, however, is not perhaps the most frequent case; for in the plurality of cases, the whole of it is either dissolved or ejected, and in both events the cavity of the new bone is left wholly empty. So far then these two cases are similar in their circumstances, and they likewise are similar in the process which they afterwards follow to dispose of this cavity. For in all those cases in which the sequestra is removed, either by dissolution or ejection, the cavity of the new bone fills completely up, so that no regular

gular vacuity remains at the end of the cure *.

The cafes in which the fequeftra is completely ejected, afford us an opportunity to obferve the procefs by which the cavity is filled up, as all the parts concerned in the procefs lie open to infpection, while the neceffary changes are going on. In the other cafe, in which the fequeftra never makes it appearance, the procefs indeed is not vifible during its pendency ; but as the cafes are in all other refpects perfectly fimilar, there can be no doubt that the cure is conducted upon the fame principles, and completed in the fame manner.

In

* See Plate IV.

In the early ſtages of Necroſis, the internal ſurface of the new oſſeous ſhell is capable of ſending out granulations from every part of the ſurface. Theſe granulations riſe in all directions, and grow with great rapidity. As the prominence of theſe granulations increaſes, the ſize of the cavity gradually diminiſhes. At laſt they meet about the centre, unite together, and form one ſolid maſs, which obliterates the cavity for ever. After this the ſurface of the ſore cicatriſes before the granulations have time to be converted into bone. The converſion, however, commences at an earlier period of the diſeaſe, among the firſt ſprung granulations. Theſe begin to oſſify before the laſt grown are completely covered over with ſkin. It may be proper to obſerve, that this deſcription is taken

from

from the caſe in which the ejection of the ſequeſtra or removal of the anterior portion of the new ſhell leaves all the proceſs in view. Thus it appears in both caſes of the removal of the ſequeſtra, whether by abſorption or ejection, that the ſubſtitute bone becomes ſolid in place of hollow.

Theſe various terminations of Necroſis are determined by the circumſtances of the caſe, and preſent a number of curious appearances in the courſe of the attack. The ejection of the ſequeſtra, for inſtance, may obtain either before the oſſeous ſhell is completely formed, or after it is fully conſolidated. In the firſt caſe, the patient will ſuffer a temporary ſuſpenſion of the uſe of his limb, becauſe the ſeparation of the ſequeſtra takes

place while the new bone is in a ſoft ſtate, and unable to bear any weight. In the other caſe, the patient is perfectly able to uſe his limb during all the time of the cure, becauſe the conſolidation of the new bone is ſufficiently advanced to ſupport every exertion it is expoſed to before the ſequeſtra leaves its place. The relation which the conſolidation of the new bone bears to the ſeparation of the ſequeſtra, produces theſe varieties.

The ſlow ejection of the ſequeſtra indicates a moderate attack of inflammation. But when the ſequeſtra ſeparates more quickly, and while the new bone is in a ſoft ſtate, the ſeparation is always the conſequence of ſevere inflammation, and is accompanied with very violent ſymptoms,

ſymptoms, and with the temporary ſuſpenſion of the motion of the limb. This premature ſeparation of the ſequeſtra occurs more frequently in the Necroſis of the lower jaw. The chin is then deprived of its natural and proper ſupport, and falls down upon the neck, exhibiting a very ſtrange and uncouth appearance.

The ſequeſtra too, without coming away altogether, ſometimes ſeparates from the old bone at both its extremities, in ſome more early period of the diſeaſe. The limb then has the appearance of having given way at two different places, in the manner of a fracture, and the patient is unable to uſe it for ſome time after this ſeparation or ſuppoſed fracture has taken place.

Such are the various appearances which cafes of Necrofis exhibit, when the fequeftra is feparating from its new covering of bone.

In the other form of the attack, where the fequeftra is removed by diffolution and abforption, without making its appearance externally, the difeafe is more uniform in its progrefs, and does not admit of fo great a variety of fymptoms. The procefs is neceffarily tedious, and always attended with a profufe difcharge of matter. But befides the general enlargement of the bone, this is the only ftriking circumftance which takes place. The quantity of matter firft gradually increafes, and then gradually decreafes, till at laft it ceafes altogether. Thefe conftitute the only vifible fymptoms in this

this form of Necrofis. For the changes which the fequeftra undergoes are concealed from fight, and are only inferred from collateral circumftances.

The diffolution of the fequeftra is more or lefs complete. In young fubjects it is more quickly and more completely diffolved. In thofe of more mature age, the diffolution of it is more tedious and uncertain. And in fome cafes a fmall portion remains unchanged, and refifts all the power of the fyftem.

As to the caufes which effect the deftruction of the fequeftra, it is plain, that only a fmall proportion of it can be deftroyed, while it remains in its natural place, united at both extremities with the permanent portions of the ori-

ginal bone, and that after its ſeparation, it is removed from the ordinary ſphere of action of the living parts of the ſyſtem, ſo that it muſt then decay from ſome other cauſe The internal and ſofter parts diſappear firſt, and probably owe their decay to the ſpontaneous decompoſition which all parts of the body naturally undergo, when they are deprived of life, and detached from the ſyſtem. The gradual operation of theſe unſeen cauſes is perhaps ſufficient to accompliſh the deſtruction of the ſequeſtra in moſt caſes. At the ſame time, their action is doubtleſs very much promoted, and the proceſs of diſſolution very greatly accelerated by the ſolvent power of the purulent matter which ſurrounds the ſequeſtra. For this conſtant maceration facilitates the ſpontaneous decompoſition of the

the detached bone, and by reducing it to a fluid ſtate, prepares it to be removed by abſorption, or to be waſhed out along with the diſcharging of matter.

It has already been obſerved, that the moſt ſevere caſes of Necroſis are thoſe in which the ſequeſtra forces its way through the oſſeous ſhell with great rapidity, and with violent inflammation and ſuppuration; and that, on the contrary, thoſe are mildeſt, in which the ſequeſtra never makes its appearance externally. The latter caſe admits of two varieties, oppoſite in their nature; one, in which the ſequeſtra is wholly conſumed or removed; another, in which it continues nearly with its original ſize unimpaired. This laſt caſe is the mildeſt of the two. And

the caufe of its fuperior mildnefs is fufficiently obvious. It proceeds from the leffer degree of irritation which the contact of the fequeftra excites upon the offific granulations of the offeous fhell; fo that in a fhort time the fequeftra ceafes to act as a ftimulus, and allows the granulations to offify and confolidate. In fome cafes the irritation is fo inconfiderable, as to give the patient very little uneafinefs or diftrefs.

It is fomewhat fingular, that the two mildeft cafes of Necrofis are fo contrary to each other, that in the one the fequeftra is entirely confumed, in the other that it remains almoft entire. The intermediate ftates are by much the moft fevere. And when no circumftances determine the fequeftra to burft from its

confinement,

confinement, and there is too much irritation to allow the parts to remain unmolefted, and too little to produce a total confumption of the fequeftra, the cafe feems to have no natural termination. It forms what be termed a chronic cafe of Necrofis, and may continue to harafs the patient for an indefinite length of time. The degree of fuffering will be greater or lefs, according to circumftances, but will always be fufficient to teaze the patient inceffantly, and to difturb the tranquillity of health.

In the Necrofis of the long bones, the offeous fhell which contains the fequeftra is always perforated with a number of holes, placed irregularly at unequal diftances *. Thefe holes correfpond to the

* See Plate I.

the external fiſtulous ſores, and are the openings through which the matter found a paſſage from the internal ſurface of the ſhell. They are commonly of a circular form, with ſmooth rounded edges. They remain in the oſſeous ſhell, without ever filling up when the cure obtains by the preſervation of the ſequeſtra. But when the ſequeſtra is totally deſtroyed, and the whole cavity of the ſhell filled up with oſſeous matter, the apertures of theſe holes likewiſe fill up; and after the cure is complete, nothing but a veſtige of them remains on the ſurface of the ſubſtitute bone.

Such then is the progreſs which in a very great number of caſes I have obſerved Necroſis to follow: And, in general, the changes which take place, admit

mit of an obvious and ſatisfactory explanation. In a few ſingular caſes, indeed, the cauſe of certain appearances is not ſo obvious. When, for inſtance, a bone ſeparates at its articulation with another bone, and from the perfect ſtate of the articulating proceſſes we have proof that no part of the original bone is left in the ſocket, there may be ſome difficulty to conceive the means which are employed to preſerve or renew the motion of the joint. The poſſibility of the caſe, however, appears from the examination of many caſes of indiſputable accuracy and authenticity. I have in my poſſeſſion, a portion of the lower jaw, which ſeparated from the reſt, in a caſe of Necroſis *. The whole condyloid proceſs is ſmooth and entire, and nothing but the

* See Plate V. fig. 4.

the covering of cartilage is wanting to make this part of the articulation complete; yet the patient was in fome meafure able to move his jaw, both while the fequeftra was feparating, and after its final feparation. The motion of the jaw, however, was very limited during the time of the feparation, and there was confiderable fwelling over the region of joint. This fwelling might help to retain the parts nearly in their natural places, and to regulate their motion; but the regular motion of the jaw was probably performed by the condyle of the oppofite and found fide, which had not fuffered from the effects of difeafe. It is plain, that the new production of bone could not poffibly occupy the articulating cavity of the temporal bone, fo long as the original condyle remained in its

its place. But after the ſeparation and removal of the original condyle, the oſſific granulations would have an opportunity to extend themſelves towards the articulating cavity, adapt themſelves to its ſhape, become attached to the cartilage, and thus ſerve all the purpoſes of the primitive condyle. In this way, the proceſs which completes the redintegration of the joint is eaſily underſtood. I never, indeed, had an opportunity to ſee above one condyle come away from the jaw of the ſame perſon. I knew, however, that inſtances are reported of both condyles ſeparating at the ſame time, and that the credibility of the aſſertion reſts upon the teſtimony of very unexceptionable reporters. For my own part, I believe in the truth of the fact, and think that the circumſtances of the caſe admit

admit of being explained. It is certain, that at one period of the procefs, the jaw is almoft clofely fhut, and next to immovable, in confequence of the fymptomatic fwelling which retains all the parts nearly in their natural places. This ftate continues till the feparation of the fequeftra removes one impediment to motion. Its feparation, however, does not at once reftore the power of motion, though it permits the offific granulations of the new bone to occupy the empty articulating cavity, and pave the way for the formation of a new joint. After this foundation is laid, and the new granulations have formed adhefions with the articulating cartilage of the former condyle, the motions begin to be made more freely, and to be regulated more accurately. The furrounding mafs of new

bone

bone gradually waſtes away, ſo that the ſhape and ſize of the parts at laſt adapt themſelves to their new ſituation. And thus the ſubſequent motion of the jaws removes any incumbrances which ariſe from the ſuperfluities of the new growth. In theſe caſes, however, the proper articulating ſurface never is deſtroyed; for the cartilage which belongs to the original bone ſtill remains in its place, and the capſular ligament is nowhere injured or opened. I never have known an inſtance in which the articular cartilage came away in a caſe of Necroſis. It ſeems, however, to undergo a change, in order to accommodate itſelf to the enlargement which takes place at the head of the new bone; for that piece of cartilage, which tips the head of the new bone, is always conſiderably broader than the

the ſurface of the original cartilage, and conſequently muſt have increaſed in ſize, in proportion to the greater extent which it had to cover. In this way thoſe changes are accompliſhed, which enable the ſubſtitute to ſupply the place of the original bone, in performing the motions of a joint.

The foregoing deſcription accords moſt accurately with Necroſis of the long bones, though the ſame principle pervades the Necroſis of every other claſs of bones, and is accompliſhed in the ſame manner, making allowance for the variations which the difference of ſhape and other circumſtances may render neceſſary. Thus, in the lower jaw, the difference of ſhape and of poſition, and of ſtructure, produces ſome peculiarities

in

in the appearances of a caſe of Necroſis. The moſt remarkable of theſe is the power of retaining the teeth on certain occaſions, and even of forming new ſockets to hold them. In this termination of the caſe, the patient ſuffers little inconvenience, as the ſubſtitute bone acquires ſufficient firmneſs to give ſupport to the teeth, and ſerve all the purpoſes of maſtication. It is obvious, however, that the preſervation of the teeth cannot be a frequent occurrence, as there is no poſſibility of it taking place, excepting in thoſe caſes in which the old jaw comes away downward, through a wound in the ſkin. For whenever the jaw ſeparates upwards, and is drawn into the cavity of the mouth, the teeth muſt neceſſarily come along with it; and from

many

many circumſtances, this is the direction which will in general prevail.

In the firſt place, the coverings of the jaw are much thinner towards the ſide of the mouth, and ſooner and more eaſily deſtroyed by diſeaſe, conſequently the jaw is oftener uncovered at the upper part, ſo that the ſeparation and detachment more frequently begins there.

Beſides, the death and ſeparation of the jaw frequently ariſes from ſome diſeaſe in the teeth or gums, which, from their ſituation, naturally determine the complaint to begin at the upper part, and to proceed downwards. All theſe circumſtances operate even in a healthy ſtate of the parts; and in caſes where a new bone is forming, the determination

to puſh the old bone upwards is ſtill more powerful. Becauſe in the formation of a new bone, the firſt ſtep of the proceſs is to accumulate a quantity of adventitious matter around every part of the jaw, excepting the upper part, into which the teeth are fixed. This deficiency muſt always exiſt. Therefore, in every caſe of Necroſis of the lower jaw, there will be a vacancy in the upper part, through which the ſequeſtra may paſs, ſo that in no inſtance can it be ſurrounded and included by the new bone. As the accumulation of adventitious matter very greatly increaſes the thickneſs of the ſurrounding parts, and ſoon acquires a conſiderable degree of firmneſs, the extraction of the jaw downwards becomes infinitely more difficult; and though it might be poſſible to ex-

tract it in this direction, yet the opening through which it muſt paſs, would neceſſarily leave a chaſm in the bottom of the caſe of new bone, which would prove an inconvenience, in ſo far as it diminiſhes the ſolidity of the ſupport. Conſidering all theſe circumſtances then, it is queſtionable how far it is prudent to attempt the preſervation of the teeth, at the expence of producing an extenſive wound in the integuments, and a chaſm in the bottom of the new bone. Beſides, it is ſeldom in our power to ſave the whole of the teeth, from the circumſtance of the vacillation and falling out of the teeth being one of the firſt ſymptoms which occurs. In thoſe caſes, indeed, in which any of the teeth are preſerved, their preſervation ariſes from the accident of ſome external fiſtulous

opening

opening having previoufly been formed, which induces the Surgeon to examine the ftate of the parts from without, to enlarge the opening by an incifion, and to extract the difeafed loofe bone downwards. Upon the removal of the fequeftra, the teeth ftill continue adhering to the gums, which fupport them in their place. In this fituation, the new bone forms round the teeth, and confolidating into a firm fubftance, keeps them as fteady and immoveable as their original fockets.

It is farther to be obferved, that the prolongation of the incifion for a fufficient length, to permit the extraction of the whole, or even of a confiderable portion of the jaw, endangers the divifion of the facial artery; and from the fize

and ſituation of this artery, a hæmorrhage from it might be very troubleſome to ſtop.

Theſe are the chief circumſtances which come into conſideration, in determining the proper place for removing any part of the lower jaw, which is looſe and moveable. But in whatever direction the jaw is to be removed, there are ſome conſequences of its ſeparation which merit particular attention. A very large nerve and artery run in the centre of the lower jaw for almoſt the whole of its length; and if the whole jaw were to come away in one entire piece, both the nerve and the artery muſt be completely deſtroyed. In general, however, the fact is, that a ſufficient portion of the internal ſurface of the bone is deſtroyed by

by erosion, to permit the nerve and artery to pass without receiving any injury *. This is the termination of all the cases of Necrosis of the lower jaw, which I have had an opportunity to examine. In every one of them the cure succeeded happily, leaving the patient the free and complete use of his jaw.

These are the principal particularities which attend an attack of Necrosis on the lower jaw, and which I have collected together, and arranged under one head, in order that they might be more easily understood and remembered.

* See Plate V. fig. 5.

SECTION V.

Seat of Necrosis.

THIS disease does not attack all the bones of the body promiscuously. It is the long bones which are chiefly liable to be attacked. Indeed, excepting the lower jaw, I know of none of the flat or irregularly shaped bones that ever become the subject of Necrosis. The bones of the cranium, of the face, the sternum, ribs, scapulæ, vertebræ, bones of the pelvis, and even bones of the carpus and tarsus, do not admit of reproduction by this process. As to the bones of the metacarpus and metatarsus and phalan-

ges

ges of the thumb, fingers and toes, they are at leaſt very rarely the ſeat of Necroſis, and do not readily admit of a cure by reproduction, when they are attacked by any ſevere diſeaſe.

Of all the bones of the body the tibia undoubtedly is the moſt frequent ſubject of Necroſis; and next, perhaps, in point of frequency, the femur and lower jaw; and then the clavicle, humerus, fibula, radius and ulna. As to the patella, I know of no inſtance in which the loſs of it has been ſupplied by a reproduction of new bone.

SECTION VI.

Duration of Necrofis.

The duration of a cafe of Necrofis is variable, depending both upon the age of the patient, and upon the circumftances of the particular bone which is attacked. The younger the patient is, however, the procefs is on every account more expeditious. The correfponding bones are of fmaller fize, of lefs firm confiftence, and all the actions of life go on with more rapidity. It is indeed difficult to lay down any general rule for the time which an attack of Necrofis requires to complete its courfe, on account

of

of the difference of time requiſite in different bones. The lower jaw, ſo far as I have obſerved, is capable of completing the proceſs in the ſhorteſt time. A cure may be completed in leſs than three months from the firſt moment of the attack. But I never have known a caſe of Necroſis of the tibia in the perſon of an adult, completed in leſs than twelve months. In general, it is a longer time, and ſometimes nearly two years. This computation is to be taken from the firſt commencement of the attack of the pain, till the final termination of the cure, when all the ulcerations have dried up, and the new ſubſtitute bone has arrived at perfect conſolidation. But, in particular inſtances, the cure is protracted to a much greater length of time. A caſe of Necroſis of the os femoris has been

five

five or fix years of completing its courfe; and during all the time of its continuance, the patient was able to difcharge the different duties of his ftation. For thofe very tedious cafes are always very mild in their fymptoms. Indeed it is impoffible they could be otherwife, elfe no ftrength of conftitution could withftand an attack of fo long duration. Accordingly, we do not find the patient complain of diftrefs, his health is not impaired, and he fuffers no inconvenience which bears any proportion to the alarming appearance of the fymptoms. For in all cafes remarkable for the flownefs of their progrefs, the fequeftra protrudes externally, and is long of feparating: So that the cafe exhibits the fingular appearance of the bone projecting through the fkin, without depriving the

limb

limb of its ſupport, and continues long in this ſtate.

From this view of the ſubject, then, it appears, that Necroſis is a tedious, though not properly a chronic diſeaſe, and that the duration of a caſe admits of conſiderable latitude even in patients of the ſame age, and when the ſame bones are the ſubject of attack.

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SECTION VIII.

Of the Age of Patients ſubject to Necroſis.

NECROSIS is properly a diſeaſe of the earlier periods of life. I have never known a caſe of it in which the attack began after the twentieth year, excepting in caſes of Necroſis of the lower jaw. About the age of puberty, or from twelve to eighteen years of age, is the time of life at which patients are moſt liable to be attacked. I have indeed known of inſtances in which the patient was ſo young, as ſix and ſeven years of age, but never heard of a caſe in which the diſ-

eaſe

caſe began at an earlier period of life. But if in all attacks upon the long bones, the patients are always in early years, in almoſt every caſe of Necroſis of the lower jaw, the patient is above thirty. In a few ſolitary inſtances, indeed, they are ſo young as ten or twelve, though this is but a rare occurrence. And to compenſate the youth of a few, we may advert to the old age of others. For the moſt advanced periods of life are not exempted from an attack of it. One patient of eighty years of age is ſaid to have loſt the lower jaw by Necroſis; but it is not clear that the loſs of the old jaw was ſupplied by the growth of a ſubſtitute. Yet in patients ſomewhat younger, though ſtill very far advanced in years, a ſubſtitute has been formed to replace the loſs.

The ſtate of the conſtitution has a great ſhare in favouring an attack of Necroſis. When this diſpoſition prevails, an individual will often ſuffer from attacks on different bones at the ſame time. I have known an attack upon the clavicle and tibia at one time. Sometimes it attacks both tibiæ. Sometimes both arms. Sometimes a leg and an arm. Upon the whole, however, it is more common that the different bones of the ſame individual ſuffer attacks at different times. And in general there is a conſiderable interval between the attacks. But while Necroſis of the long bones may be cotemporary in their commencement, it never happens that a Necroſis in one of them exiſts at the ſame time with a Necroſis of the lower jaw. And this ſurely is a very ſingular circum-

ſtance

ſtance in the human conſtitution; ſince we naturally ſhould expect, that the ſame general diſpoſition would prevail over all the bones of the body at the ſame time. On the contrary, however, experience ſhows, that in early life the long bones, and in the advance of years, the lower jaw are prediſpoſed to ſuffer from Necroſis.

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SECTION IX.

Causes of Necrosis.

OF the causes of Necrosis, no very satisfactory account can be given. It seems, however, evidently to be connected with that state of the constitution which depends upon the age of the patient. I am likewise inclined to believe, that it more readily attacks those who have a scrophulous taint in their constitution. But farther than this I know of no circumstance which predisposes to an attack of Necrosis.

SECTION X.

Occasional Causes.

When the constitution of the patient is otherwise predisposed to Necrosis, any occasional cause which is capable of exciting inflammation, may occasion an attack of it. In many cases, however, it is purely a sporadical disease, not referable to any external cause. There is no external hurt, no violence to produce the inflammation which ushers in the attack of Necrosis. And what seems remarkable, those cases of Necrosis which originate in some external injury, generally occur in the lower jaw. For this reason,

cafes of Necrofis of the lower jaw may often be traced to the effects of blows, of toothach, efpecially if a violent attack of inflammation has been excited by the application of any acrid fubftance to a carious tooth, of falivation occafioned by mercury, of fmall-pox, of fcurvy, of expofure to cold exciting pain, and the ufual concomitant fymptoms. At the fame time, it muft be acknowledged, that farther than thefe caufes tend to excite general inflammation, there is nothing peculiar in their operation which contributes to favour an attack of this diforder.

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SECTION XI.

Diagnosis.

THERE are various morbid affections of the bones, with which a case of Necrosis may possibly be confounded; though, if due attention be paid to the discriminating circumstances, one is almost certain of avoiding a mistake. The cases which bear the nearest resemblance to Necrosis, are properly two in number. But another case is often brought in as a third.

The *first* is a general enlargement of a bone.

The *ſecond*, a caſe of common exfoliation of an external lamella.

And the *third*, what has been termed a caſe of internal exfoliation.

A general enlargement of a bone ſimply from its increaſe of oſſeous ſubſtance, is diſtinguiſhed from a caſe of Necroſis by different ſymptoms. A ſimple increaſe of ſize is not neceſſarily or conſtantly attended with pain at the commencement of the diſeaſe. The date of its commencement is much more indeterminate, and its progreſs vaſtly more gradual and ſlow. The external ſoft parts are neither ſwelled nor inflamed, nor do they adhere to the bone beneath. And as the caſe is not attended with ſuppuration, there are no fiſtu-

lous

lous ulcers to diſcharge matter. Theſe are the chief circumſtances of difference between the two caſes.

The exfoliation of an external lamella of bone likewiſe admits of diſcrimination. It is indeed only in ſome caſes, and in certain ſtages of thoſe caſes, that any reſemblance obtains between the two diſeaſes. The reſemblance is greateſt when the ſequeſtra is ejected ſpontaneouſly, and is much decayed before it comes out. If the ſequeſtra be leſs than half a cylinder, and be worn very thin, it will more nearly aſſume the appearance of a ſuperficial exfoliation. But even in this ſtate it is poſſible to mark ſome difference; becauſe a ſequeſtra is generally much more ragged at its ſides and extremities, which are provided with

more long ſharp projecting points *. The ſequeſtra is more frequently perforated with holes which penetrate through its whole thickneſs. Beſides, there is leſs difference in the ſmoothneſs of the convex and concave ſurfaces. But in a caſe of common exfoliation, the difference between the degree of ſmoothneſs of the two ſurfaces is much more remarkable. The convex ſurface being in general evidently ſmoother than the concave. Such are the differences which reſpect the appearance of the bone after it is completely ſeparated.

In the act of ſeparation too, other diſcriminating circumſtances may be noticed. The point of the bone is never directed ſo obliquely in a caſe of ordinary

* Plates II. and IV.

nary exfoliation; and the kind of motion which the loofe portion admits of is very different. In a cafe of common exfoliation, the exfoliating portion may be depreffed or elevated by the application or removal of external preffure, on account of the bed of granulations which fupport it beneath. But while the granulations permit the motions of elevation and depreffion, they prevent any lateral or longitudinal motion, by growing over the edges of the exfoliating lamella, and confining it on every fide. A fequeftra, on the contrary, even when no more than a fmall portion of the furface prefents externally, admits of motion upwards and downwards in a longitudinal direction with great freedom, but cannot be depreffed, becaufe it refts not upon a

ſoft cuſhion of granulations, but upon a firm ſupport of bone.

In a caſe of exfoliation too, the granulations are leſs firm, of greater extent, and allow a probe to be introduced between them and the ſurface of the bone. And as they ariſe from a diſeaſed bone, they are often of exquiſite ſenſibility, which is not the caſe in Necroſis, where the baſis of the granulations is ſound.

The bone alſo feels rough, and in moſt caſes of exfoliation, any irritation excites excruciating pain.

The attack of the diſeaſe is much more limited in its extent, and not accompanied with any general ſwelling of the limb. If the bone enlarges at all, it

it is only to a ſmall diſtance above and below the ulcer, and then it is not ſurrounded by any ſwelling of the ſoft parts.

Next the diſcharge of matter. As to quality, it is in general fœtid and thin, and the quantity is not ſo great in proportion to the ſurface of the ſore. The complexion of the ulcer is much more unfavourable, and it never is elevated above the level of the ſurrounding ſurface, in form of little papillæ. Theſe are the ſymptoms which I ſhould conſider as affording the moſt characteriſtic diſtinctions between a caſe of Necroſis and of common exfoliation of an external lamella of bone.

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The laſt head, the diſtinction between a caſe of Necroſis and what is termed a caſe of internal exfoliation, muſt be treated entirely in a different manner, ſince it is not clear that ſuch a caſe actually exiſts. So far, at leaſt, as I have been able to inveſtigate the ſubject, it appears to me that the account which authors have given of this form of the attack is altogether erroneous. For any caſes of it, the hiſtories of which are related in detail, ſeem plainly to be caſes of Necroſis, ſo ſtrongly characteriſed in their leading ſymptoms, that it is a matter of ſurpriſe, to find that any other view of the diſeaſe had been ſuggeſted. Without entering farther into particulars, it is pointedly mentioned, that the new ſhell of bone was in ſome caſes half an inch, and in other a whole inch thick, and that the exfoliation was

quite

quite moveable under this arch. Now, both circumſtances coincide with ſymptoms of Necroſis, but are incompatible with thoſe of an internal exfoliation; becauſe the external lamella could neither acquire ſo prodigious a thickneſs, nor would there be room within it to permit ſo free a motion in the ſeparated lamella. Mr CHESELDEN alſo deſcribes purulent matter iſſuing through holes in the bone, in a manner exactly ſimilar to the diſcharge in caſes of Necroſis. So ſtrongly indeed am I impreſſed with the idea of a miſtake, that I cannot help thinking, that in ſome inſtances the life of the patient has been ſacrificed to the want of performing a proper and ſeaſonable operation to remove the ſequeſtra.

This

This opinion of an internal exfoliation involves a doctrine which is not supported by any fact or experiment. It supposes that the cancelli for containing the marrow are destroyed by disease; that the disease extends through part of the substance of the bone, but stops there, and produces a separation from the external shell, or lamella, which remains unaffected. Now, all this is a mere conjecture. The truth is, that all the experiments of Mr TROYA, and of every person who has repeated them, go to prove the direct contrary. Since from every one of them it invariably appears, that the total destruction of the marrow is the most certain means to occasion the death of the whole original bone, and to produce a new growth. And since in every other respect the analogy is so complete in all the

the circumſtances which attend a caſe of Necroſis, it is ſcarcely poſſible to entertain a doubt, that the ſame conſequences would follow, if the ſame experiments were transferred to the human body. It is indeed truly to be regretted, that no diſſection was made of the limbs of thoſe patients who fell victims to the ſeverity of the ſuppoſed caſe of internal exfoliation of the tibia. The bare inſpection of parts would have cleared up every doubt. And in my belief, it would have ſhown to ſatisfaction, that the moveable exfoliation was a complete ſequeſtra of the whole ſubſtance of the tibia, and that the covering of bone was entirely a new production.

Internal exfoliations indeed frequently attack the bones of the cranium. I have

have ſeen various inſtances of ſuch exfoliations. But among a great variety of morbid affections of the long bones, I never have ſeen a ſingle caſe which bore the moſt diſtant reſemblance to what has been termed a caſe of internal exfoliation. And I never met with any hiſtory of a caſe ſuppoſed to be of this nature, which did not to me ſeem liable to many material objections. Indeed, the authors were all ſo palpably under ſome miſtake or miſapprehenſion, that I have no heſitation in excluding this caſe from any conſideration in the diagnoſis of Necroſis.

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SECTION XII.

Prognosis.

In predicting the event of a case of Necrosis, it is a satisfaction to be assured, that, upon the whole, the disease is not of a dangerous nature. It never attacks a part whose action or existence is essential to the preservation of life. In many of the bones of the body, the patient's life is never brought into danger by an attack of Necrosis. He always survives an attack upon the lower jaw and superior extremities, however tedious and severe the disease may prove. It is alone from attacks upon the inferior

rior extremities, the femur and tibia, that fatal confequences are to be dreaded. And even in them the attack is danger-ous only in fevere cafes of the difeafe, and under very unfavourable circum-ftances.

An unfortunate termination may be expected, when the primary attack of inflammation is very violent, fo that the fymptoms fucceed one another in a ra-pid fucceffion, and with great feverity. The immediate confequences of the at-tack, the pain, irritation and copious difcharge of matter foon induce an in-curable hectic fever. This form of the complaint is always a very ferious one. It precedes the reproduction of the bone; and the degree of danger attending it, is to be eftimated by the feverity of the

particular

particular ſymptoms, and by the height to which the hectic fever proceeds. In all caſes of Necroſis, however, it is a conſolation, the worſt alternative which can be preſented to a patient's choice, is that of ſubmitting to loſe his limb, in order to ſave his life.

If the patient ſurmounts the danger which attends the incipient ſtage of the attack, the ſucceeding ſtage is far leſs dangerous. For once the primary inflammation is mitigated or ſubdued, there is no particular danger to be apprehended while the new bone is forming. The duration, however, of this interval of ſecurity is very uncertain. And whenever the ſequeſtra becomes moveable, and begins to irritate the internal ſurface of the new bone by fric-

tion, a return or increaſe of pain and diſtreſs may be expected. When the ſequeſtra remains confined within its new covering, without making any effort to eſcape, the ſymptoms of the diſeaſe are ſeldom violent. Hectic fever, if it ſupervene at all, is in a moderate degree. But if the ſequeſtra, in place of remaining at reſt, ſhows a ſtrong tendency to force a paſſage through the oſſeous ſhell, if this proceſs proceeds with too much rapidity while the new bone preſents conſiderable reſiſtance, the ſequeſtra, without completely extricating itſelf from its confinement, excites a very high degree of irritation, ulcerations ſpread all over the ſurface of the limb, and aſſume an unhealthy appearance, violent general fever ſucceeds, till at laſt the concurrence and continuance

of

of all thoſe ſevere and unfavourable ſymptoms, reduce the patient to a ſtate of moſt imminent danger. This ſtage forms the laſt critical period of the attack, ſince the diſeaſe muſt here terminate either in the deſtruction or recovery of the patient. If the force of the diſeaſe prevails over the ſtrength of conſtitution, death ſucceeds, or at leaſt the patient muſt conſent to loſe his limb by amputation. If the ſtrength of the patient's conſtitution ſubdues the virulence of the diſeaſe, then the ſequeſtra is completely ejected, and nothing farther remains to interrupt the progreſs of the cure. In this ſtage, the eſtimate of danger is to be taken from the impreſſion which the local affection makes upon the general ſtate of the patient's health. If a morbid ſtate of the ſoft parts produces

an ulceration all over the ſurface of the tibia, and a hectic fever takes poſſeſſion of the ſyſtem, then the ſafety of the limb is very greatly endangered. Comparatively ſpeaking, however, this ſtage of Necroſis is not ſo dangerous, nor ſo completely out of the reach of help, as that which attends the violent attack of inflammation which ſupervenes immediately after the commencement of the diſeaſe.

Upon the whole then, it appears, that the Necroſis of the clavicle or ſuperior extremities never proves fatal; and that even in the inferior extremities, although Necroſis always proves a tedious and ſevere diſeaſe, it very rarely terminates fatally. I never yet have witneſſed an inſtance of the patient's life falling

ing a sacrifice to the attack: So that taking every circumstance into account, Necrosis appears to be in all cases a most distressful disease, but in very few a fatal one.

SECTION XIII.

Method of Cure.

The ultimate object of all the foregoing researches, is to ascertain the most scientific, judicious and certain method of cure; and happily there is no instance in which the successful investigation of the true nature of a disease can lead to more valuable improvements in practice.

It is perfectly evident, that an attack of Necrosis admits of no relief from any general treatment of the constitution. The disease is perfectly local, and too deeply

deeply rooted in the ſeat of attack, to yield to the impreſſion which any general remedy can make; ſo that any pretenſions to cure, or even to relieve an attack of Necroſis by any courſe of internal medicine, is quite prepoſterous.

There is even much reaſon to queſtion, whether any real benefit can be derived from the uſe of topical applications. It is true, the diſeaſe commences by an attack of inflammation. But then the inflammation is always ſo deep ſeated, and often ſo ſevere, that no local treatment has power to prevent or to check it. The common practice in caſes of local inflammation, topical blood-letting, and the application of cooling aſtringent ſolutions, has little effect in this particular caſe. Becauſe, beſides the depth and

violence of the inflammation, there is probably ſome tendency to terminate in a peculiar way; ſo that the means which are ſufficient to counteract an attack of ſimple inflammation, prove leſs effectual in this. No other practice, however, is applicable on the occaſion, and a trial of it is naturally ſuggeſted by the intenſity and continuance of the pain; ſo that whenever an attack of Necroſis is ſuſpected, it is certainly adviſable to try the uſual means of counteracting inflammation: And it is clear, that whatever degree of efficacy theſe means poſſeſs, they can be attended with advantage only at the incipient ſtage of the attack. It muſt, however, always remain a matter of doubt, how far the uſe of them is beneficial, ſince the proof of the exiſtence of the diſeaſe, immediately upon

its commencement, is too obſcure to permit of much certainty. Yet as the practice is perfectly innocent, and cannot poſſibly prove injurious, no objection appears againſt giving the patient every chance of relief which the uſe of it affords. But if the attack be not at once ſubdued, or its approach averted, we muſt then expect the diſeaſe to follow its natural progreſs, in which art can do no more than to regulate the courſe of the attack in ſome particular circumſtances.

The firſt period of danger is the moſt critical and delicate to manage. And as the ſafety of the patient's life is endangered from the extent and violence of the inflammation, before the new ſhell is formed, or the ſequeſtra looſe and rea-

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dy to ſeparate, the aſſiſtance of art can be of little ſervice, becauſe any premature attempt to extract the ſequeſtra by force, would neceſſarily increaſe the degree of inflammation, exaſperate all the ſymptoms, and augment the patient's danger; ſo that the palliative and inert practice of applying emollient poultices and warm fomentations is all that the caſe admits of. If this treatment does not ſucceed, there is no alternative but amputation. Whenever therefore the patient's ſtrength is ſinking, from the effects of a hectic fever, and the local diſeaſe proceeding with uncontrollable rapidity, there is no room for delay. The conſtitution being in general ſound, and in a ſtate ſufficiently favourable for an operation, the patient is almoſt certain to recover.

But

But if the patient has the good fortune to ſurvive this ſtage of the attack, or if the diſeaſe is not ſevere at its commencement, the caſe then preſents itſelf under a more advantageous form to receive aſſiſtance from art. The removal of the ſequeſtra may be accelerated. And indeed the ſole object of practice through the whole courſe of the attack, conſiſts in removing the ſequeſtra at a proper time. It is likewiſe obvious, that there are two oppoſite ſtates of the complaint, in which no interference is neceſſary, and where indeed it would certainly be prejudicial.

The firſt ſtate is that in which the ſequeſtra is diſſolving and carried out of its place, without ever making its ap-

pearance

pearance externally, or giving any considerable diſturbance to the conſtitution.

The ſecond ſtate is that in which the ſequeſtra is eſcaping from its confinement, without violence, and without being the occaſion of much uneaſineſs or inconvenience.

In both thoſe ſtates of diſeaſe the ſymptoms are ſo moderate, and the cure and recovery ſo certain, that every kind of aſſiſtance is wholly ſuperfluous. Indeed, the chance is that it would tend to aggravate rather than to alleviate the diſtreſs. Becauſe every operation is neceſſarily attended with pain, and followed by inflammation; and thus a great deal of diſtreſs may needleſsly be pro-

duced

duced in a cafe where none would o-therwife take place.

But in the intermediate ftate of the difeafe, where the prefence of the fe-queftra is a perpetual fource of irritation, the affiftance of an operation becomes re-quifite to bring the difeafe to a happy iffue by the removal of the féqueftra. It is however a point of nicety to determine the proper time to perform the opera-tion. Since the time of performing it may be too early or too late.

It is early and premature when the difeafe, though begun, is in the way of removing the fequeftra, without either producing an external opening, or crea-ting much difturbance to the conftitu-tion. Becaufe, under thefe circumftan-

ces,

ces, the caſe would terminate in a favourable manner, if left to follow its natural courſe.

It is too late when the caſe has been permitted to go on ſo long, that the ſequeſtra is almoſt totally deſtroyed, and the cavity which contained it obliterated before any attempt is made for its extraction. For by that time the patient has been expoſed to all the pain, inconvenience and danger, which the attack could poſſibly occaſion. And the operation, far from relieving the patient, and accelerating the cure, creates diſtreſſing ſymptoms, which did not before exiſt, and thus prolongs its duration; ſo that an operation performed under theſe circumſtances is not only unneceſſary, but even highly pernicious, and ought therefore

fore to be avoided. Whenever, then, a caſe of Necroſis is preſented for examination and advice, all theſe particulars ſhould meet with due attention before we deliver our opinion on the ſubject.

Two principal varieties of the diſeaſe come more immediately under conſideration. The one is that dubious caſe in which the exiſtence of the ſequeſtra is not marked by the preſence of any external viſible obvious ſymptom.

The other caſe * is that in which a portion of the ſequeſtra is either ſimply naked and expoſed, or elſe with the extremity projecting, and in the act of endeavouring to force its way out, but prevented from eſcaping, by the reſiſtance it meets

* Plate V. fig. 1, 2, 3.

meets with from the partial or complete formation of an offeous fhell.

To confider thofe two cafes in their order.

In the firft cafe we muft be fatisfied of the exiftence of the Necrofis, and of the prefence of a fequeftra, to juftify the idea of an operation. And even then, if the pain be moderate, and the patient fuffers little inconvenience from the complaint, an operation is quite fuperfluous. But on the contrary, if, along with the fame obvious marks of Necrofis, the patient fuffers fevere local pain in the limb, if his fyftem is perpetually haraffed with fymptomatic fever, and his ftrength daily declining, from the greatnefs of the irritation, and the profufe evacuation of

matter,

matter, it then becomes a queſtion of prudence, to determine how far an operation will afford him relief. There is not the ſmalleſt doubt that if a large ſequeſtra be impriſoned and cannot eſcape, the diviſion of the caſement, and removal of the ſequeſtra will be of the moſt eſſential ſervice, and procure immediate eaſe. But then the difficulty conſiſts in aſcertaining the exact ſtate of the parts which lie within the centre of the limb, concealed from ſight. We may expect, however, to arrive at an approximation to the truth, by adverting to different circumſtances. Of theſe, two of the moſt material, are the duration of the complaint, and the age of the patient. Since it is obvious that the longer the diſeaſe has continued, the ſequeſtra will have made the greater progreſs in falling into

 decay,

decay, and that the celerity of its diſſolution will be much modified by the patient's age. A caſe of Necroſis in a grown ſubject, in whom the ſequeſtra is large and ſolid, and the actions of the ſyſtem more tardy, requires a longer time to finiſh its courſe. In a young ſubject, on the contrary, every one of theſe circumſtances favours a more ſpeedy termination of the caſe. The complex nature of the inveſtigation, indeed, does not admit of perfect accuracy. But there is one caſe which throws much light upon this point of the ſubject. It has ſometimes happened that both limbs have been affected with Necroſis at the ſame time, and attacked preciſely together; both of them likewiſe have been the ſubject of operation, and, from motives of prudence, the two operations have been

performed

performed at a conſiderable diſtance of time from each other. In this interval, the parts had undergone great changes. And, as the two caſes were in all reſpects ſimilar, the changes undergone, meaſures the progreſs of the diſeaſe in this interval of time. In one patient, a lad of eighteen, the firſt operation was performed about three months after the commencement of the diſeaſe, and a large ſequeſtra extracted. Five months after this, the ſame operation was performed upon the other leg. But by this time there was ſcarcely a veſtige of the ſequeſtra remaining, and the cavity of the bone was nearly obliterated. In another patient of thirteen years of age, the reſult was wonderfully ſimilar. But, as the patient was ſomewhat younger, the progreſs of the diſeaſe was rather more

rapid. Accordingly, in the interval of five months, there was not a veſtige of the ſequeſtra left remaining, and the cavity of the bone was more nearly obliterated. In both caſes too the new bone was harder, more ſolid, and infinitely more difficult to cut at the time of the ſecond operation. So that, by comparing the two periods of operating, the ſuperiority of an early operation appears in a very ſtrong light. Indeed, in both caſes the ſecond operation was quite uſeleſs, and perhaps pernicious, ſince nature would, without the aſſiſtance of art, have completed the cure in a very ſhort time, and in a much eaſier manner. In like manner, in other caſes where the operation had been poſtponed to a late period, the cavity was nearly obliterated, the ſequeſtra nearly conſumed, and the

offeous

offeous fhell confolidated to a degree of hardnefs which made the excifion of a portion of it almoft impracticable.

The practical inference to be deduced from thefe facts is apparent. It follows, that whenever we are fatisfied of the exiftence of a cafe of Necrofis, and from the violence of the fymptoms, convinced that the patient muft expect a long continuance of fuffering, with a tedious and uncertain cure, it is clearly of advantage to operate early, fince by that means we not only abridge the duration of the patient's diftrefs, but from the fuperior foftnefs of the bone operate with greater facility. It is farther evident, that the advantage gained by avoiding delay is the greater the farther the patient is advanced in life, becaufe, from the greater

ſize and hardneſs of the bone, the caſe would neceſſarily prove more ſevere, and be protracted to a greater length. The exact limit of time which affords moſt advantage from operating, cannot indeed be given with perfect preciſion, though perhaps about three months from the commencement of the attack is the moſt proper time to decide upon the line of practice. By that time the diſeaſe is completely formed, and has made ſufficient progreſs to indicate the courſe which it is likely to follow. It is not unuſual too, that at this period the diſeaſe puts on an alarming appearance, which induces the patient to apply for advice.

Theſe are the indications which ariſe from conſidering the age of the patient and duration of the diſeaſe. But be-

ſides

ſides this ſource of information, we may derive aſſiſtance by attending to the local circumſtances of the caſe. If, for example, the pain be abating, and the diſcharge of matter diminiſhing, it is probable that the ſequeſtra is conſuming very faſt, and will ſoon be completely deſtroyed. To confirm this idea too, it is poſſible to examine the ſtate of the bone, without proceeding to any ſevere operation. For this purpoſe it is ſufficient to uncover different portions of the bone, of no great extent, near where the fiſtulous openings are, and by introducing a probe, or, if that be impracticable, by making perforations with a ſmall drill, to explore the ſtate of the cavity. If, upon this examination, we diſcover that the cavity ſtill is extenſive, and contains a ſequeſtra of conſiderable

ſize, the neceſſity of operating becomes apparent. On the contrary, if the whole of the cavity be filled up with oſſeous matter, and no remnant of ſequeſtra is to be found, theſe circumſtances clearly indicate the propriety of truſting the cure entirely to nature.

Theſe ſeem to me the conſiderations which ought to regulate the conduct of a practitioner at the firſt period of the caſe, in which the ſequeſtra does not appear externally.

In the other period for operation, the point of practice is not nearly ſo delicate, nor ſo difficult to decide; for then the expoſure or protruſion of the ſequeſtra removes all uncertainty as to the nature of the caſe. Under theſe circumſtances, an operation

operation is in general adviſable to accelerate the removal of the ſequeſtra, and in ſome caſes its ſpeedy removal is abſolutely neceſſary, in order to ſave the patient's life. The only caſes indeed in which an operation may be diſpenſed with, are theſe in which the ſequeſtra ſeparates ſo ſlowly as to cauſe no ſenſible degree of irritation. In caſes of Necroſis of the femur, indeed, this point doubtleſs is of very material importance, becauſe the bone lies at a conſiderable depth through moſt of its extent, the exact ſtate of the diſeaſe cannot be ſo accurately known, and the operation to be performed is infinitely more ſevere. But in the tibia, where the covering of ſoft parts is more moderate, much leſs reſerve is neceſſary; and unleſs there be a total abſence of pain and of uneaſineſs

of

of every kind, the ſequeſtra ought immediately to be removed. In truth, the indication is ſo extremely obvious, that when the ſurgeon is entruſted with the management of the caſe from the beginning, there is little opportunity to commit any miſtake of material detriment to the patient.

But if the patient by negligence, or from want of opportunity, has allowed the complaint to proceed to an imprudent height, the moſt advantageous ſeaſon for operating may then be irrecoverably loſt. Still, however, this is no reaſon to withhold the aſſiſtance of an operation; for although it may prove leſs effectual than we could wiſh, yet it will be attended with no danger, and will neither accelerate the progreſs nor aggravate the

ſeverity

ſeverity of the caſe. Even in the moſt unfavourable and deſperate circumſtances under which an operation would be attempted, the removal of the ſequeſtra may afford ſome temporary mitigation and relief; ſo that it ſeldom is too late to operate, however little benefit we can promiſe the patient from the ſucceſs of the practice.

Thus it appears, that the removal of the ſequeſtra is the only mode of practice admiſſible in a caſe of Necroſis; and that when the exiſtence of the diſeaſe is clearly aſcertained, and the irritation produced conſiderable, we can ſcarcely be too early in performing the operation to extract the ſequeſtra. On the contrary, that we ſhall be infinitely too late, if we delay operating until the ſequeſtra

queſtra be totally conſumed, and the cavity completely obliterated. In theſe caſes, the ſequeſtra is concealed from ſight, by the ſurrounding growth of new bone. But in the other claſs of caſes, in which the ſequeſtra appears externally, either by expoſure or protruſion, there is no time too late to operate; and it is plain, that, in ſuch caſes, we never can operate too early.

The preceding obſervations properly pertain to idiopathic caſes of Necroſis, which ariſe without any external injury, though with very little change they may be transferred to thoſe caſes which are occaſioned by the irritation of a compound fracture, and thus have a very different origin. The progreſs, however, of thoſe ſymptomatic caſes may be

exactly

exactly ſimilar to the others, and they admit of an equally great variety in their mode of terminating. For ſometimes the fragments of the old bone, which correſponds to the ſequeſtra, become inert, and remain impriſoned within the new ſhell, without producing any inconvenient degree of irritation. At other times they prove the ſource of inceſſant and intolerable irritation, and require to be immediately extracted, by the removal of a portion of the new oſſeous ſhell. The prudence of either line of practice will depend upon the exigency of the ſymptoms, though in general a conſiderable degree of irritation ſeems to be an inſeparable attendant of a Necroſis forming from this cauſe. As yet, however, there is no obſervation in point, to determine whether the fragments of the

broken

broken bone have ever been diſſolved and removed by abſorption, and the new formed cavity filled up and obliterated, though there ſeems nothing in the nature of the caſe inconſiſtent with this termination. The formation of the new ſhell extends no farther than what is ſufficient to include the whole extent of the fractured portion. The nature of its ſubſtance is exactly the ſame as in other caſes of Necroſis, and the cure muſt be conductd upon ſimilar principles.

In certain parts of the body, an attack of Necroſis never leads the ſurgeon into any dilemma with reſpect to the exiſtence of the diſeaſe, the preſence of the ſequeſtra, or the neceſſity or propriety of removing it. All attacks upon the lower jaw are of this claſs; for as the old bone

never

never is completely ſurrounded by the new one, it cannot be ſo long confined as to prove a permanent cauſe of irritation. In ſuch caſes, accordingly, we have not ſo much to apprehend inconvenience from the too long confinement of the ſequeſtra, as from its too ſpeedy ſeparation. And this diſparity of circumſtances leads to an inconvenience of a totally oppoſite nature; becauſe, in conſequence of it, the old bone frequently comes out prematurely before the new bone is fully conſolidated, ſo that the chin becomes flexible and pendulous, and loſes its natural form. When this accident happens, it becomes neceſſary to ſubſtitute ſome artificial ſupport, in place of the natural one which is withdrawn. And if by the application of a ſolid [illegible] frame

frame, the ſoft parts be all retained in their proper relative places, the rudiments of the new bone, if it be already laid, will gradually conſolidate, till at length it acquires the requiſite degree of ſolidity, firmneſs and ſtrength to perform the office of the original jaw. This is the onlymanagement requiſite in ſuch caſes.

There is likewiſe a peculiarity in ſome caſes of Necroſis of the long bones, which require a ſimilar management. It was before mentioned, that in certain caſes the ſequeſtra ſeparates at both extremities before the new ſhell has time to become firm, and afford ſupport to the limb. This variety of the attack, however, is not attended with pain or with danger, and the concomitant inconveniencies are

easily

eafily corrected. Since all that is neceffary is to keep the leg extended upon a common fplint, until it has acquired fufficient firmnefs to fupport its own weight, without bending or breaking.

This finifhes all the remarks I intended to offer upon the nature and treatment of Necrofis, and nothing farther remains but to explain the operation neceffary to perform for the extraction of the fequeftra; but before proceeding to this branch of the fubject, it will be proper to advert to a propofal which has been made to attempt the diffolution of the fequeftra, by injecting an acid liquor into the cavity of the new bone. The muriatic acid in a diluted ftate is the beft adapted to this purpofe. It is fufficiently efficacious as a folvent, and not the

ritating as a ſtimulant. At the ſame time, I ſhould be afraid there was no poſſibility of ſufficiently guarding againſt the inconveniencies of injecting an acrid liquor into the cavity of the new bone. If the ſequeſtra be very large and very ſolid, it muſt require a long time and a frequent repetition of the injection to diſſolve it completely. And all this while, the whole internal ſurface of the new bone muſt be expoſed to the action of the ſolvent. Nor is there any means of computing the pernicious conſequences which this expoſure may produce. The experiment has never yet been made, and probably never will, as it is not eaſy to conceive any advantage which a cure by a chemical menſtruum poſſeſſes over [illegible] it ſo [illegible]echanical ope- [illegible] certainly would not be p[illegible]per

per to attempt a cure by injection, except under the same circumstances that it would be advisable to operate; and in using the injection, there always would be some difficulty in determining whether or not the sequestra was completely dissolved. In no respect, then, is there any motive to give it the preference over the common and more simple method of cure. It is only applicable under the same circumstances, it is more tedious and more troublesome in its use, more uncertain in its effect, and probably infinitely more painful and more dangerous in its consequences; so that I regard this proposal as one of those speculative projects in surgery which does not merit a trial in practice.

The Operation.

THE operation to be performed in caſes of Necroſis is neither delicate nor difficult, and requires no ſuperior judgment or dexterity. It conſiſts in extracting the ſequeſtra through an aperture in the new oſſeous ſhell.

The parts expoſed to be cut do not endanger the patient's life, and are not remarkably ſenſible. The firſt ſtep of the operation is to lay bare the bone; and this may be ...ed either by ...calpel or by the applica...n of

of cauſtic. But the former method is far preferable, both becauſe it is more expeditious, and does not neceſſarily ſubject the patient to the loſs of ſkin. Beſides, the operation of cauſtic is more painful, and the depth and extent of its action more uncertain. The uſe of cauſtic, therefore, ſeems to be without advantage, and is wholly inadmiſſible.

The place, direction, and extent of the external inciſion is to be determined by the number and ſituation of the fiſtulous openings in the ſkin. A portion of the new bone under one of theſe openings, ſufficient to permit the ſurgeon to explore the ſtate of the parts beneath, is firſt to be laid bare. In this ſpace he will probably di[illegible]ge do[illegible]ening in the bone, which leads directly to its [illegible]nal cavity; for in general every exter-

 nal

nal fiſtula is produced and ſupported by ſuch an opening, and correſponds nearly to the place of it. If this opening in the bone be ſo narrow or ſo irregular in its courſe, that a probe cannot be made to paſs, then, in order to aſcertain the exact ſtate of the diſeaſe, the next ſtep is to bore a ſmall hole in the bone, by means of a perforator or common drill. If the bone be hollow, with a large cavity in the centre, the perforator, after penetrating through the thickneſs of the oſſeous ſhell, will go ſuddenly down from the want of farther reſiſtance; becauſe there is nothing to oppoſe its progreſs, till it meet with the internal ſurface of the ſhell on the oppoſite ſide. Here it is again ſtopped, and by meaſuring the diſtance betwee[illegible]on and renewal [illegible]ance, we aſcertain the length of

of the diameter of the cavity of the new bone. A number of ſimilar perforations made at different diſtances, and at ſuch places as the external openings indicate, determine the ſtate of the central parts of the bone. Becauſe, if the cavity be filled up, the perforator is always felt to be cutting a ſtratum of ſolid matter. The pain which attends the making of theſe perforations is not conſiderable; but it is of conſequence that the point of the perforator be always ſo directed as to paſs through the centre of the bone, in order that it may afford a fair meaſure both of the thickneſs of the ſhell and of the diameter of the cavity; becauſe, if it paſſes in any other direction, the obliquity of its courſe gives a falſe meaſure of all the paſſage doe[illegible] which it paſſes, the thickneſs of the bone appearing greater,

greater, and the diameter of the cavity lefs than the truth. By this falfe eftimate, we fhould judge the cure to be nearer complete than what it is in reality, and confequently neglect to purfue the neceffary meafures. After the perforatoris withdrawn, we may introduce a probe in its place. And if the perforation be large, and the probe fmall, then it admits of being bent, fo as to explore the ftate of the whole internal cavity, and determine both its extent, and whether or not it contains a portion of undiffolved fequeftra. By proceeding in this manner, we have it in our power to afcertain all the circumftances which are requifite to be known previoufly to the laft and moft effential ftep of the operation.

The

The ſkin, if it be in a ſound ſtate, need not be removed, when the portion of bone to be removed is not of great extent. But if either the ſkin be unſound, or a conſiderable portion of bone is to be cut out, it then becomes neceſſary to remove a correſponding portion of the ſkin. It may be obſerved too, that the ſeparation of the ſkin from the bone is more troubleſome than in ordinary caſes, becauſe the adheſions are greater, and the diviſion of parts leſs diſtinct, in conſequence of the previous inflammation, and the want of the perioſteum.

The temporary hæmorrhage which occurs in cutting through theſe parts, is neither conſiderable nor troubleſome, and ſeldom is [illegible] or continues

ſo long, as to diſturb or impede the operator.

After all the ſuperficial parts are removed, the next ſtep is to cut out a portion of the new formed bone; and when this is ſtill in a ſoft ſtate, the whole of the operation may be performed by means of a common ſcalpel, provided it be ſtrong, and of a large ſize, becauſe the ſtratum of new bone, previous to its complete oſſification and conſolidation admits of being cut with a ſharp knife. This, however, is but rarely the caſe at that period of the diſeaſe when an operation is requiſite for the removal of the ſequeſtra; for by this time the oſſification of the new ſhell is in general ſo complete, and every par[illegible]rmly conſolida[illegible]d, [illegible] no inſtrument makes any impreſſion

preffion upon it, which is not capable of cutting through a hard, folid and thick bone. A faw of fome kind, therefore, is commonly requifite to complete the operation; which may be performed in two different ways. The operator may either make a number of different perforations with the head of a trepan*, placing them in contact with each other, fo as to form one continuous opening; or he may make a deep incifion at the top and bottom of the bone, by means of a circular faw, and then cut out the intervening portion, by the ufe of a googe and mallet. The laft method is the moft expeditious. But it is not equally well adapted to every cafe of Necrofis; for when the bone is thick and hard, the googe does not eafily cut [illegible] through

* Plate V. fig. 6. and 7.

through ſo firm and ſolid a ſubſtance. Accordingly, caſes have actually occurred, in which it was ſcarely poſſible to complete the operation, by means of theſe inſtruments. It likewiſe expoſes the operator to greater riſk of cutting out more of the bone than what is abſolutely neceſſary, and thereby making an opening, and leaving a ſore of ſuperfluous extent. No perſon, therefore, would wiſh to employ this method of operating, when the bone is very thick and firm, and the ſize of the ſequeſtra unknown; ſo that the advantage of expedition is fully compenſated by other leſs favourable circumſtances.

The uſe of the trepan is not liable to theſe objections. There is no hardneſs or thickneſs of bone which it is unable

to penetrate and remove. If it is not ſo expeditious, it is more certain; and as the aperture is gradually extended, we have it in our power to ſtop whenever a ſufficient width is opened to permit the extraction of the ſequeſtra: For as this is the ultimate object of the operation, the poſſibility of extracting it is a meaſure of the requiſite aperture. The gradual enlargement of the opening likewiſe affords us an opportunity to judge how far any advantage may be gained, by breaking down the ſequeſtra into ſeparate pieces; for if it be of a large ſize, we may often very much facilitate the extraction of it by this means. It alſo frequently happens, that the ſequeſtra is firmly wedged in at the extremities, though it be looſe at every other part; and in theſe caſes, removing a po[illegible]

from

from one end, allows the whole to be eaſily withdrawn. By this expedient, we ſave the patient all the inconvenience of making a larger opening, and of leaving a larger extent of ſurface in the ſtate of an open ſore; ſo that whenever the aperture in the bone is of ſufficient ſize to permit the extraction of the ſequeſtra in ſeparate pieces, it always is adviſable to have recourſe to the diviſion of it. In general, it may be divided by means of cutting pliars; or if it be too hard and ſolid to yield to them, it is always poſſible to remove a portion of it, by applying the head of a trepan; in one way or other the object is certain of being attained.

The expoſure or protruſion of the ſequeſtra makes no material difference in the

the operation. It removes indeed all uncertainty as to the exiſtence of a cavity containing a ſequeſtra, and helps to determine the direction of the inciſion, and the number of perforations requiſite, and on theſe accounts renders every circumſtance eaſier. But after the ſequeſtra is removed, the limb is exactly in the ſame condition in both caſes. It is plain too, that after the perforations have been made by the trepan, it is neceſſary to remove the angular prominencies, by means of ſome other inſtrument.

The removal of the ſequeſtra completes the operation, which, though tedious, is not painful in proportion to the ſeverity of its appearance. The patient no doubt ſuffers diſtreſs, and the length of his ſuf-

ferings

ferings may wear out his patience, as the operation ſometimes laſts for half an hour, or even for a longer time. But what he ſuffers is not ſufficient to induce faintneſs, or to excite ſuch a degree of irritation as is likely to be followed by much fever, conſequently the after ſymptoms are in general ſufficiently mild.

The mode of dreſſing the ſore after the operation is not a matter of difficulty. The ſimpleſt dreſſings anſwer beſt. A large emollient poultice, which covers the whole limb, gives the leaſt irritation, and ought therefore to be preferred. It requires to be changed three times a-day. In leſs than a week, the whole ſurface of the ſore aſſumes a healthy aſpect, and the cavity of the bone

becomes

becomes covered with granulations *. Theſe granulations gradually extend themſelves till they fill up the whole cavity, and reach the level of the ſurface. They are of a more ſolid conſiſtence than the granulations which riſe from the common ſoft parts, and have much the appearance of a piece of healthy gum. After granulations have ariſen from every part of the ſurface, and a healthy ſuppuration is eſtabliſhed, it is no longer neceſſary to continue the application of the poultice, and in its place a dreſſing of ſimple ointment may be ſubſtituted. No farther alteration of dreſſing is required in the ordinary circumſtances of the cure.

* See Plate IV.

The growth of the granulations gradually fills up the cavity of the new bone, and once they have arrived at the level of the ſurrounding parts, their ſurface is covered over with a thin pellicle of ſkin. This pellicle becomes by degrees thicker and firmer, till it at laſt arrives at the ſtate of a perfect cicatrix. In this way the wound cloſes before the oſſifications have pervaded the whole ſubſtance of the granulations; but in time every part acquires a proper degree of firmneſs, though the progreſs of the change can no longer be obſerved.

The cure, from the removal of the ſequeſtra till its final completion, requires, in caſes of Necroſis of the Tibia, from four to ſix months; and in other bones a longer or a ſhorter time, in proportion

to

to their ſize, and to the age of the patient.

At the beginning of the cure the patient muſt confine himſelf to bed, and muſt continue in it till the granulations have grown to the level of the ſurface, and have begun to receive a covering of ſkin. After this period he may be indulged with greater liberty, but muſt at all times be cautious of overdoing, and content himſelf with walking ſhort diſtances at firſt, with his leg ſuſpended in a ſling.

The treatment of the conſtitution under the cure is not difficult, as the ſore in general forms a ſimple ulcer, which requires no particular management of the patient's general health. If any

pain, irritation or reftleffnefs fucceed the operation, a dofe of laudanum will compofe the patient, and ought to be repeated occafionally, if the return of uneafinefs makes it requifite. The articles of diet fhould be fuch as are fufficiently nourifhing, without being too ftimulating. At firft it fhould confift chiefly of vegetable food, and in the progrefs of the cure of a moderate allowance of animal food. Care muft likewife be taken to obviate any troublefome degree of coftivenefs, and with due attention to all thofe different particulars, there is feldom much difficulty in conducting a cafe of Necrofis to a happy termination.

When the cure is finally completed, the fubftitute bone is filled up with folid matter, and becomes in every refpect

ſimilar to a caſe of Necroſis, in which the ſequeſtra had been wholly conſumed, without making its appearance externally. The affected limb indeed is left larger and leſs ſhapely than the other, but in fulfilling all the uſeful purpoſes of life, its functions are no ways impaired; for the patient is not ſenſible of bearing an additional weight, nor does he ſuffer any other perceptible inconvenience.

CONCLUSION.

The appearances which a caſe of Necroſis exhibits are ſo ſtriking, that one might expect them to have attracted the notice of the earlieſt practitioners in ſurgery, and to have been recorded in the writings of the firſt authors; yet notwithſtanding the very curious nature of the diſeaſe, no mention is any where made of it till the time of Albucasis, an Arabian Phyſician, who is ſuppoſed to have lived towards the cloſe of the eleventh century; and the deſcription which he gives of the caſe, proves clearly that he did not underſtand the nature of it. After this date a long interval of ſilence ſucceeds,

ſucceeds, and no farther mention is made of the diſeaſe till ſix hundred years after the æra of ALBUCASIS, when SCULTETUS, an eminent German Surgeon, gives a wonderfully diſtinct and accurate deſcription of a caſe of Necroſis, and of the operation performed to cure it. It is ſingular, however, that ſo memorable a caſe, and ſo ſucceſsful practice, had no immediate tendency to advance the knowledge, or to improve the treatment of the diſeaſe. For ſoon after SCULTETUS publiſhed his work, we find authors of the firſt note in the profeſſion deſcribing caſes of Necroſis with little intelligence, and with that blind admiration of particular ſymptoms, which is the never failing concomitant of ignorance. So ſlow, indeed, has the progreſs of improvement been, that even ſome of the moſt eſteem-

ed authors of modern times do not appear to have underſtood the diſeaſe with much accuracy. The celebrated Mr CHESELDEN moſt certainly miſtakes a caſe of Necroſis for a diſeaſe of a very different kind. Mr GOOCH of Norwich performed a ſucceſsful operation, in a caſe of Necroſis, conſequent to a compound fracture of the Tibia, without ſeeming to underſtand the nature of the affection. And the late Dr WILLIAM HUNTER, who has left ſome elegant deſigns of the moſt intereſting morbid appearances which occur in Necroſis, is quite unable to offer any adequate and ſatisfactory explanation of the manner in which they were produced. To this liſt of diſtinguiſhed men I might, if it were neceſſary, add the names of ſome reſpectable living authors; ſo that I am ſufficiently

ciently authorifed to confider the true nature of Necrofis as not yet fully and generally underftood. I might farther add, that the ignorance of fome of the moft important particulars, has introduced a line of practice far from judicious and correct.

In this imperfect ftate of our knowledge, a field of improvement ftill remained open, to reward the labours of thofe who chofe to profecute the inquiry; and as my fituation afforded me many opportunities to obferve cafes of Necrofis, under all their various forms, and my inclination led me to beftow particular attention upon the fubject, I foon found that my collection of materials was fufficient to illuftrate the principal points of the difeafe. I was fully perfuaded that

that a fyftematic view of the fubject was wanting, and that the only way to lay the foundation of any folid improvement in future, was to connect all the infulated facts by fome general principle. To fulfil this object, I have endeavoured to arrange my thoughts in the form of a methodical fyftem, which, however deficient in other refpects, at leaft poffeffes the merit of originating from the actual examination of the appearances in nature.

THE END.

Plate

Fig. 1.

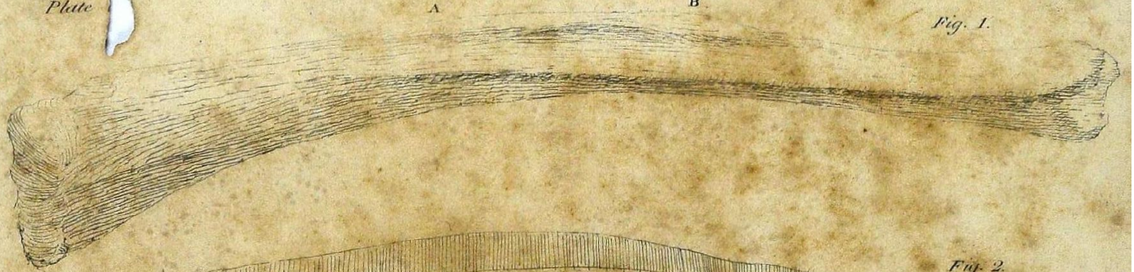


Fig. 2.

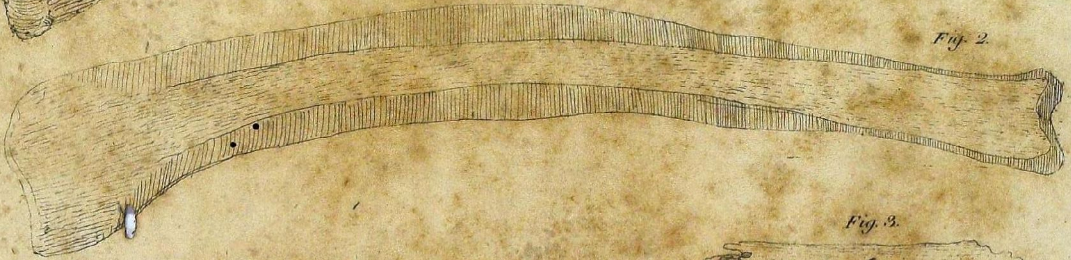
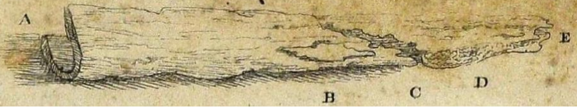


Fig. 3.

Fig. 4.



The annexed plates are intended to illuſtrate the different circumſtances which occur in a caſe of Necroſis: And as the original drawings were all taken from nature, immediately under my own inſpection, I can thoroughly truſt to the accuracy and fidelity of the repreſentation.

But before I proceed to give a particular explanation of the different figures, it will be proper to conſider the true import of the term Necroſis, and the particular circumſtances which it is employed to denote. The term is of Greek original, derived from the word Νεκρος, which ſignifies dead. Accordingly, in the application of it to the diſeaſe in queſtion,

ſtion, reference is more directly made to the decay of the old bone than to the formation of the new one, and in ſo far it gives but a partial view of the diſeaſe: For although the death and ſeparation of the old bone be the moſt obvious and ſtriking ſymptom, it is not the moſt curious and important; ſo that in this reſpect the term Necroſis is not happily choſen. It will therefore be of advantage to confine our attention ſolely to the eſſential ſymptoms of the diſeaſe, without regarding the etymoligical meaning of the name.

In every caſe of Necroſis then, we ought to remember, that the formation of new parts conſtitute an indiſpenſable ſymptom of the diſeaſe; and it is the chief purpoſe of theſe plates, to explain

the

the manner in which theſe new parts form, and the appearances which they ultimately exhibit. But while this is the firſt and principal object, they likewiſe repreſent the different progreſſive ſteps which accompliſh the ſeparation and ejection of the old bone.

The three firſt plates are intended to illuſtrate the progreſſive changes which take place in the formation of the new parts.

In the firſt, the change is repreſented as complete. Accordingly, we there ſee a portion of the old bone, very much eroded by diſeaſe, incloſed within a newly formed ſhell, which entirely ſurrounds it. This figure then repreſents the characteriſtical ſymptoms of a caſe of Necroſis,

in

in its complete ſtate; and it is evident from inſpection, that the new oſſeous ſhell forms the moſt curious and intereſting part of the preparation.

In the ſecond plate the diſeaſe is not ſo far advanced. The formation of the new bone indeed is perfectly diſtinct, though it does not yet form a complete cylinder.

The third plate repreſents the diſeaſe in the incipient ſtage, when the rudiments of the new bone are beginning to form. The continuity of the old bone is ſtill preſerved, but towards the two ends an eroſion is beginning, and which, by increaſing in depth, will at laſt produce a complete ſeparation. The moſt intereſting appearance, however, is the accumulation of a quantity of ſoft matter along the

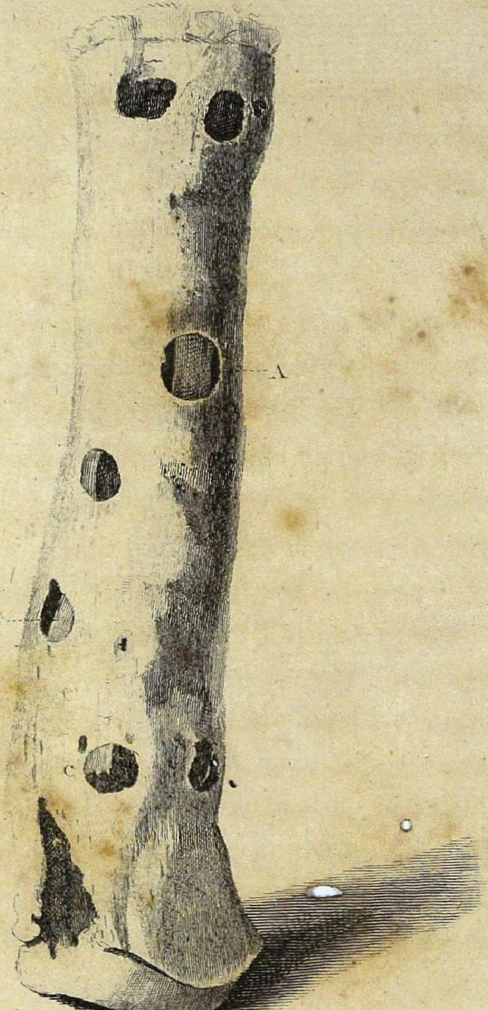
the whole length of the limb. In this ſtratum are depoſited the oſſeous particles which form the new bone. The oſſification is already begun in one ſpot, and by extending itſelf, will at laſt complete the conſolidation of the ſubſtitute.

Thus the inſpection of thoſe three plates ſerves to explain the progreſs of a caſe of Necroſis.

It is perhaps no eaſy matter to give a conciſe, clear and technical definition of the term Necroſis, though the meaning which it is intended to convey will be ſufficiently underſtood, by attending to this ſhort deſcription of the leading appearances repreſented in the annexed plates, eſpecially if the more full explanation of the particular plates be read at the ſame time.

The ſame name is likewiſe extended to caſes which are not altogether ſimilar in their circumſtances, although the cure be conducted upon the ſame principles. To thoſe caſes, for example, in which a portion of the original bone being removed by deſign or accident, the neighbouring parts depoſite a ſtratum of oſſific matter, which at laſt conſolidates into ſolid bone. This caſe, however, does not occur frequently: There can be no ſequeſtra nor hollowneſs in the ſubſtitute, ſo that it never follows the progreſs of an idiopathic attack. The neceſſity, therefore, of including it as a neceſſary part in the definition of the diſeaſe may poſſibly be queſtioned, though there can be no doubt of the propriety of explaining it as an appendix.

PLATE I.



D. Lizars Sculp.t

Explanation.

PLATE I.

THE figure reprefented in this plate exhibits the ufual appearances of a cafe of Necrofis of the Tibia, in which the cure is completed, without the ejection or deftruction of the original bone. Accordingly, we have here a diftinct view both of the new formed offeous fhell, perforated with holes, and of the fequeftra included within it, and lying loofe. The letters A, B, C, indicate the holes through which the fequeftra may be feen, C indicates the lower extremity. The upper extremity is concealed from fight,

by a portion of the osseous shell which is not perforated. At A, where the whole thickness is visible, the sequestra appears smaller than what the diameter of a tibia of this length ought to have been in its natural state. But to explain this, two circumstances are to be noted. First, that the substance of the tibia may have been somewhat wasted by that decay which a bone suffers when it becomes dead, and loses all connection with the living part. Secondly, it would be fallacious to imagine, that the sequestra had ever equalled the length of the new shell, as this shell may have been considerably elongated since the time that the sequestra separated from the remaining extremities of the tibia. Probably there was in this case an interval of years between the time of the separation of the

sequestra

ſequeſtra and the death of the patient, and during all this time the ſubſtitute bone would continue to grow, while the ſequeſtra would neceſſarily remain of its original ſize. Thus, the diſproportion between the ſize of the ſequeſtra and of the ſubſtitute bone is a neceſſary conſequence of the circumſtances of the caſe at the time of the patient's death; and the great mobility of the ſequeſtra is ſufficiently accounted for.

The general aſpect of the figure repreſents the external appearance of the ſubſtitute bone. It has no regular ſhape. It is much thicker in proportion to its length than any bone of the human body. There is a total want of thoſe characteriſtic features which marks the form of every original bone in its natural ſtate.

There are no particular hollows, or rough and prominent edges to ſerve for the inſertion of muſcles, no diſtinct variation of form in different parts, no regular apophyſis. In ſhort, there is nothing graphical about it, to appropriate the figure peculiarly to a certain bone of the body.

At the lower end the cartilage is diſtinctly ſeen, with a more extenſive ſurface than is uſual. This extenſion of ſurface correſponds with the changes which takes place in conſequence of the enlargement of the bone, and is one of thoſe concomitant circumſtances which neceſſarily attends a caſe of Necroſis. The new ſhell is perforated with a number of holes, diſpoſed at unequal diſtances, and in an irregular manner. There

are

are in all ſeven viſible in this point of view. The regularity of their ſhape is very remarkable. They are all ſmooth at the edges, which are worn thin, and bevelled from the inſide, like the holes of a muſical wind-inſtrument. Their form, and the ſhape of their edges, is produced by the conſtant diſcharge of purulent matter through them, which diſpoſes the holes to aſſume a circular ſhape, and wears their edges thin. The number and poſition of theſe holes is purely accidental, and their commencement is coeval with the original formation of the new bone.

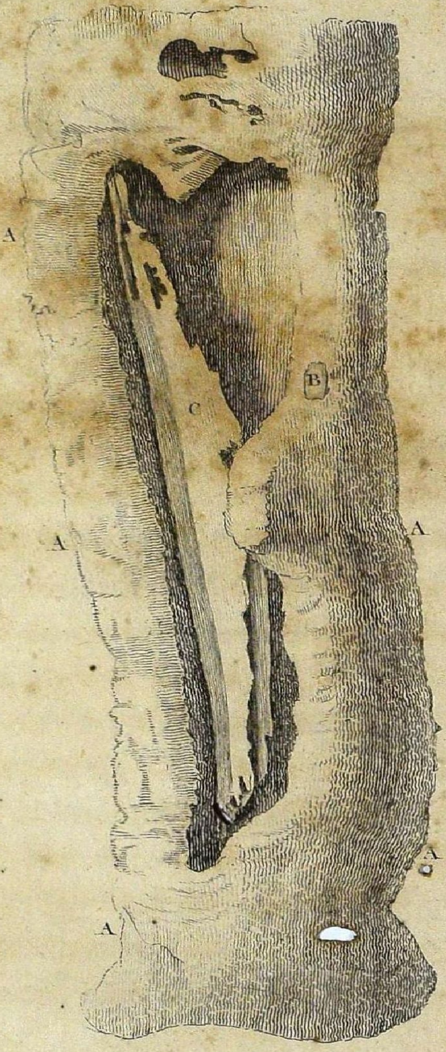
Theſe are the moſt remarkable particulars which preſent themſelves on the inſpection of this figure, which very clearly exhibit the eſſential characters

of a bone formed in conſequence of Necroſis.

The irregular ſhape of this bone naturally ſuggeſts a doubt how far the action of the muſcles contributes to give a particular form to the original bones of the body, ſince this ſubſtitute bone was ſubjected to the action of the muſcles of the leg during all the time of its formation, without aſſuming any characteriſtic ſhape, in conſequence of their action. But as this queſtion is more of a ſpeculative nature than what belongs to the proper ſubject of this eſſay, I ſhall wave any farther diſcuſſion of it on the preſent occaſion.

Explanation.

PLATE II.



D. Lizars Sculp.t

Explanation.

PLATE II.

THIS figure repreſents a caſe of Necroſis of the Tibia, in an intermediate ſtage of advancement. The formation of the oſſeous ſhell A A A, A A A is complete, excepting at the anterior part. But here there is deficiency the whole length of the bone, nearly equal to one fourth of the cylinder. Through the opening which this deficiency leaves, the ſequeſtra C is ſeen lodged in the hollow of the new bone. It extends almoſt the whole length of the hollow, and when it was entire, muſt have occupied nearly all

all the empty ſpace. But in its preſent ſtate it is conſiderably decayed, eſpecially towards its two ends; and here, in particular at the upper end, it exhibits that ragged prominent pointed appearance which ſo much characterizes the extremity of a ſequeſtra. Near to the top, a hole is eroded through the whole thickneſs of its ſubſtance. A ſmall portion is likewiſe deſtroyed upon one ſide, which makes the cylinder imperfect. But the other ſides are in their natural ſtate, with ſmooth ſurfaces and angular edges.

The oſſeous ſhell A A, *&c.* is open on its anterior edge from one end to the other, but originally the cylinder was complet near to the middle, ſo that the openings above and below were ſeparated from each other, by a portion of

bone

bone nearly an inch in length. It was neceſſary, however, to remove this oſſeous bridge, in order to permit the extraction of the ſequeſtra; and it is this circumſtance which has given the appearance of a complete deficiency on the anterior part.

This new oſſeous ſhell is fully oſſified through the whole thickneſs of its ſubſtance, and is perfectly firm, ſolid, and ſtrong. It is very full of blood-veſſels, ſo that the central parts have been made red with injection. The two ſurfaces, eſpecially the external ſurface, is covered with ſoft granulations, about an eight part, of an inch thick; and when theſe granulations are removed, the ſurface of the bone itſelf is tolerably ſmooth. The ſurface of ſeparation between the bone

and

and the granulations is perfectly diſtinct, there being no gradation in the converſion of the one kind of ſubſtance into the other. What is not conſolidated is quite ſoft. And the oſſifications do not always take place in immediate contact with the ſurface of the oſſeous ſhell, and by adhering to it increaſe its bulk by gradual additions. On the contrary, it is more uſual for an oſſific nucleus to form at a little diſtance from the ſurface of the parts already oſſified, and after it has increaſed in ſize, to attach itſelf to the new ſhell. An oſſific nucleus of this kind is denoted by the letter B. It is about the ſize of a common barley-corn, and is entirely unconnected with the other oſſified parts. In this reſpect the proceſs of oſſification in the new ſhell agrees with its progreſs in the formation

of the original bone. Though this circumſtance is more apparent in the earlier periods of the attack, the texture of the new bone appears at that ſide which is ſtraight and flat; and from the inſpection of this figure, it is evident that it is not compoſed of concentrated lamellæ, ſuch as would be ſeen in a longitudinal ſection of an original tibia, but is more of an homogeneous texture, though the fracture is not quite ſmooth. The edge of one ſide lies nearly parallel with the ſurface of the ſequeſtra; and ſome ſuch accident has probably given riſe to the opinion, that a new bone had been formed along ſide of the old one. There does not, however, ſeem to be any juſtice in the opinion; and perhaps, upon more accurate examination, the reſt of the

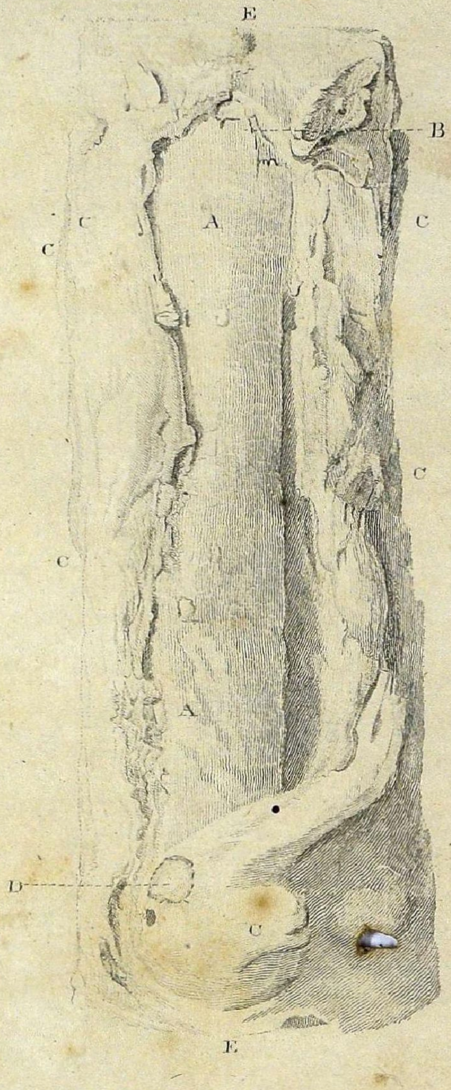
the osseous shell would have been disco-
vered, and have explained the illusion.

From the best account which could be collected of the history of the case, the disease must have existed about ten or twelve months.

The figure is drawn to a scale nearly of one half of the size of the original.

Explanation.

PLATE III.



D Lizars Sculp.

Explanation.

PLATE III.

The preparation which this figure repreſents, was taken from a caſe of Necroſis of the Tibia, in which the diſeaſe had laſted only for twenty-four days from the commencement of the attack. It therefore exhibits the formation of new parts in their incipient ſtate, and thus ſerves to illuſtrate the firſt and leading ſteps in the progreſs of the diſorder.

The tibia A A appears in the middle, in its natural place, and very nearly of

its natural appearance. It ſtill forms one entire piece, though the whole ſeems to be in a ſtate of high inflammation, as it has an unuſual and preternatural degree of redneſs over the whole ſurface; and as this great degree of redneſs proceeds from the general diffuſion of a ſize injection, it ſhows that the connection between all the parts of the bone ſtill remains uninterrupted. At one place B, however, near to the upper end, a ſeparation is already beginning to take place. As yet, indeed, it has not made any conſiderable progreſs. But as the proceſs of ulceration was ſufficiently rapid, it ſoon would have effected a complete ſeparation of the bone, though until the ſeparation was completed, the bone would continue to ſerve as a uſeful ſupport to the limb. A ſimilar eroſion had actually

ly begun towards the lower end, though it was concealed by the covering of the adjacent parts. When the ſeparation was complete in both places, the middle portion would be entirely detached from the two extremities, and thus form the ſequeſtra of a Necroſis. Here then we plainly diſcover the origin of the ſequeſtra, and may eaſily trace the way in which it is produced.

Next, as to the origin of the oſſeous ſhell. All around the bone, A A, there is depoſited a ſtratum of ſoft materials, C C C C. This ſtratum is in moſt places nearly half an inch thick It is extremely vaſcular; uniform in its texture, and ſomewhat firmer in conſiſtence than the granulations which riſe from ſoft parts in a healthy wound. But in the other parts

of

of its ſtructure, it very much reſembles them. The opening which appears in the ſeparation, was made by the inciſion of a knife, in order to give a view of the parts beneath; for the ſtratum of new matter went completely round the leg, and concealed them from ſight. In general, the oſſification had not begun, but in one point, D, an oſſific nucleus is perfectly formed, and probably the whole maſs was in a ſtate which prepared it to aſſume a ſimilar change. In a very ſhort time, therefore, the oſſification might have taken place through all the ſubſtance of the depoſited ſtratum. For after oſſific granulations are in a fit ſtate for oſſifying, the conſolidation of the whole maſs may be completed in a ſhort time, by the oſſification beginning in different places at once. And this ſeems

to

…he ordinary courſe which the proceſs follows, both in natural and morbid caſes. In ſome inſtances, indeed, oſſific ſpiculæ proceed from a commo… …ntre, and radicate after an irregular … …ner, and to a conſiderable diſtance, n… …ike the ramification of a vein of metal … matrix. When this proceſs obt… which is but rare, all the oſſificat… are connected together from the … In the other caſe there are ſeparate p… of oſſification, but the oſſific nuclei … unite together, and compoſe one c… nuous maſs.

Theſe are the principal …ppearances wh… preſent themſelve… to view in the ex… …ination of thi… …gure, and they ſerve w… to illu…ate various leading circ…ſtances in the hiſtory of the diſeaſe.

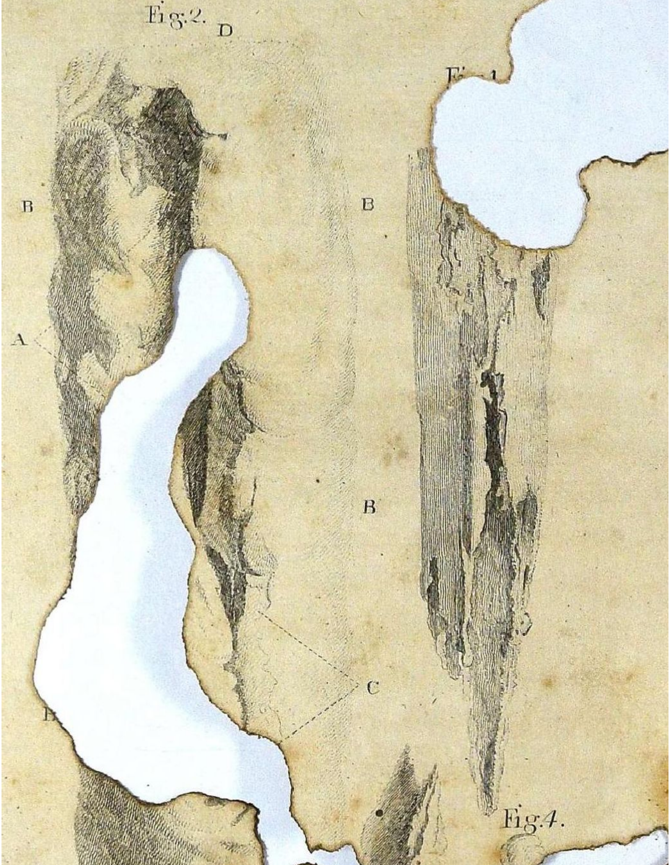
N They

They ſhow clearly that the new
begins to form before the old one ſepa-
rates and dies, and even that it may be
conſol[illegible]ted and able to bear the weight
of t[illegible]ody before the other becomes
uſel[illegible] All this appears, by obſerving
[illegible]ne ſequeſtra is not nearly detach-
[illegible]om the extremities of the tibia, while
[illegible]mplete ſtratum is laid for the depo-
[illegible] of oſſeous matter, and the oſſifica-
[illegible]s already complete in one place.
[illegible]e it is eaſy to conceive by what
[illegible] a patient may preſerve the power
[illegible]ing during the pendency of the
[illegible] the caſe is mild. It is far-
ther obvio[illegible] that there is no neceſſity the
marrow ſh[illegible] killed or deſtr[illegible]ed,
previouſly to the co[illegible]encement [illegible] the
new ſhell.

E E, the extremity of the tib[illegible]

Explanation

PLATE IV.



Explanation.

PLATE IV.

THIS plate contains four figures, w
all relate to the ſame caſe of Necroſi

Fig. 1. repreſents the ſequeſtra
portion of the tibia, about five i
long. There is nothing ſingular
markable in this ſpecimen.
prominent pointed rugged e
to all ſequeſtras, and it inally be-
to the limb ed in figure

 This

This figure (Fig. 2.) e... of Necrosis under cure. ...e cavity from which the seque... x-tracte... B B B the ossific granulations whic... ng to the new osseous shell, and ... n are very luxuriant in their ... . At C, where the naked bone ... een exposed and irritated, a thin la- ... is separating by exfoliation. The ... ted portion is represented separate- ... gure third. D D D, the sound part ... limb. The inspection of this fi- ... ows with what luxuriance and ir- ... the ossific granulations grow ... wing was taken eighteen days after ... sequestra (Fig. 1.) had been extrac... , in this short ... the cavity is so very ... filled ... it would not have a ... a b... more than half the diameter. And ...

parts

ontinue to grow with the
fa it is plain that the whole
of would ſoon be completely
obliterated. From this inſtanc may
form a tolerable eſtimate o time
which would be requiſite to fi arge
ſpace in the ſame manner, whic
certainly diminiſh our wonder at th
lerity with which a ſubſtitute bone g
and conſolidates. The granulatio
every where prominent, and proje
yond the edge of the ſound parts.
this circumſtance accounts for the
unſhapely, and clumſy appeara
the limb will aſſume after
cured. Theſe granulatio egin to ci-
and to be with ſkin at
es, fr n the new ſkin makes
al adva towards the centre, till
t the whole ſurface of the granula-

 tions

tions is covered. There i
mit to their elevation abo
the ſound parts, though in g is
not co erable before the cicatrization
begin puts a ſtop to their farther
grow he bone lies at no great depth
the ſurface of the granulations;
henever they are ſcraped off, that
on of the bone which is expoſed,
fails to exfoliate. This is more
xpreſſed in figure third, which re-
ts the lamella, (Fig. 2.), after it
arated by exfoliation. The edges
thin as the fineſt cambrick
ards the middle it becomes
more ſolid a thick. The thin parts are
perforated b mber of ſmall
The ſeparation of effect
the uſual way, and was conſeq
of the irritation which the oſſeous

ſuffered

removal of a ſmall piece,
e extraction of the ſeque-
ſtr

Fig. 4. repreſents this piec he oſ-
ſeous ſhell, which was remove neans
of a pair of cutting pliers, and wh
about three-eighths of an inch thic
other reſpects, there is nothing re
able in its texture or conſiſtence.

PLATE .V.

Explanation.

PLATE V.

THE three firſt figures of this plate ſhow the uſual appearances of a ca[illegible] Necroſis, when the ſequeſtra is v[illegible] In figure firſt it is only expoſed. [illegible] gures ſecond and third, it protrude[illegible] the three figures agree in the rep[illegible]tations they give of the ulceration[illegible] likewiſe of the clumſy ſhape of th[illegible] in conſequence of, the large ſiz[illegible] [illegible]ſtitute bone. In [illegible] three figures, [illegible]er A indic[illegible] the external ulce[illegible]ns. [illegible]ey are placed irregularly, [illegible]e courſe of the tibia, and are all of them

them elevated above the f
of sm ll papillæ. A ſmall
the centre is of a red colo are
firſt, B repreſents a portion of the ſeque-
ſtra, bare and expoſed. It is at a con-
ſiderable diſtance from either extremity,
and does not protrude through the open-
ing in the new bone. C C, granula-
tions connected with the new bone, which,
in colour, firmneſs, and conſiſtence, re-
ſemble a bit of healthy gum.

In figures ſecond and third, B B in
like manner indicates the naked ſeque-
ſtra. But in both theſe caſes, the extre-
mity of it is ſeen projecting a conſider-
able way beyond the ſurface of the
bone. The two figures are given
der to ſhow the progreſs which t
queſtra makes in protruding, in the c

of

. Figure ſecond is the figure third the ſecond. In ne lower part of the ſequeſtra ars farther down the leg. The extremity too is not ſo pointed, the ſharp points having been worn down by friction. C C denotes the granulations connected with the new bone, which grow up behind, and fill up the vacancy which the ſequeſtra leaves, as it advances ward. So that, in the caſe of a pr ding ſequeſtra, the cavity of the new bone is nearly filled up at the time the ſequeſtra is ejected. Perhaps, indeed, the growth of theſe granulations has ſome ſhare in puſhing it out. It is likewiſe e- nt that a proceſs of this kind muſt ily be ſlow and tedious.

Fig. 4.

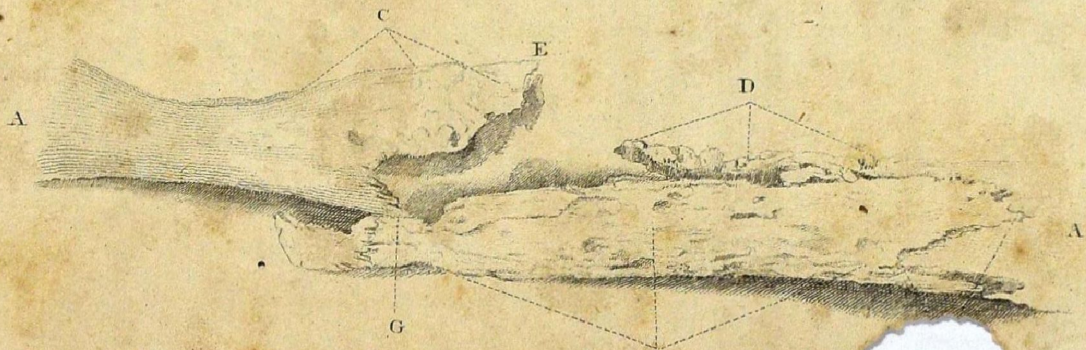
Fig. 4. a portion of the
the angle. The condyloid
plete, and has the articul A
ſmooth and entire. B, part of the coro-
noid is worn away. The patient, from whom this preparation was taken, could maſticate, though not much, during the pendency of the diſeaſe.

Fig. 5. a portion of the lower jaw, near to the mental hole, in which part of the inner table is eroded ; ſo that the nerves and blood-veſſels were not torn by the removal of this ſequeſtra. A indicates the alveoli a little impaired by diſeaſe. B a conſiderable chaſm in the inner part, occaſioned by the eroſion which m
way for the paſſage of the ner
blood-veſſels.

Portions of the new of-
...ure first, cut out with a trep... ...ermit the extraction of the sequestra. At the thinnest part, the shell seems to have been above a quarter of an inch thick.

Explanation.

Plate VI.



Explanation.

PLATE VI.

A CASE of compound fracture, in which the cure was going on, upon the principle of a caſe of Necroſis. A A indicates the healthy portions of the Tibia. B B part of the Tibia, which was ſeparating from the healthy extremity at F. C D pieces of new oſſeous matter, which was extending from one of the healthy extremities to the other. When this pre-ration was freſh, a quantity of ſoft ter filled up the whole interval be- n the extremities, and this was the in which the oſſifications began, and which

which would at laſt have connected the extremities together. In this fracture, the extremities of the bones at G overlapped, and could not be replaced. Conſequently, as is evident from inſpection, the thickneſs of the bone muſt intervene between the upper ſides of the two portions, and likewiſe between their under ſides. So that the new growth which proceeds from the upper ſide of one, muſt be at a diſtance from the other, and can have no dependence on the perioſteum of either. Thus, for example, the point of the oſſification at E is removed, both from A, and from any part of B. It cannot poſſibly, therefore, originate from the perioſteum. Beſides, in the caſe from which this preparation was taken, the perioſteum belonging to the whole portion B, was deſtroyed by inflammation,

and

and ſo could have no ſhare in forwarding the proceſs. Independently, however, of this circumſtance, the mechanical difficulty, in caſes of compound fracture, in which the bones overlap, is of itſelf ſufficient to prove that the union of the extremities, on the principles of Necroſis, cannot be accompliſhed by the perioſteum.

This is likewiſe explained in the Text, pages 18. and 19.

FINIS.

ERRATA.

Page 7. Catchword, and

—— 8. First word, *for* these *read* this

—— 75. Line 13. *for* knew *read* know

TO THE BOOKBINDER.

Each Plate is to front its respective Explanation.

APPENDIX.

APPENDIX.

THIS ſhort Appendix contains the hiſtory of two caſes, which occurred ſince the materials were collected for compoſing the body of the Eſſay.

CASE FIRST.

THE firſt caſe preſents an inſtance of a complete cure of nine years ſtanding, in which a portion of the tibia, of about three inches in length, had been thrown out in one entire piece, and its place

completely ſupplied by the growth of new bone. Both the ſeparated portion of the original tibia and the new formed ſubſtitute bone, are now in my poſſeſſion, and ſerve to illuſtrate ſome points of the diſeaſe in a clearer manner than any other preparation which has hitherto been deſcribed. The portion of the original tibia exhibits nothing remarkable. (It is repreſented in Fig. 3. Plate vii. where this and the other two, the 1ſt and 2d, are all drawn to the ſcale of one half the linear meaſure of the original preparations.) It is plainly a portion of the complete cylinder of the bone, ſo that all the ſubſtance which now ſupplies the place which this before occupied muſt be entirely new growth. The patient was about ſix years old at the time of the attack. After an interval of nearly

nine years, ſhe died of a diſeaſe in the head, and thus afforded an opportunity to examine the ſtate of new bone. Upon comparing the two legs together, they were found to be of equal lengths, only that one which had formerly been the ſeat of diſeaſe was now ſomewhat incurvated, being convex forward; and upon the anterior part of the leg, correſponding to this incurvation, there was an extenſive cicatrix, the veſtige of the large wound which had been made by the expulſion of the original bone. The ſkin over the whole extent of this ſurface was ſhining, thin, and attached to the bone below. After removing the integuments and other ſoft parts, the naked bone appeared of a regular ſhape, and was everywhere covered with a membrane, which adhered firmly to its ſur-

face, and had all the appearance of a natural perioſteum. This regularity of ſhape was a circumſtance I did not expect, as all the former caſes which I had enjoyed an opportunity to examine were recent caſes, in which the new bone was ſtill clumſy, large and unſhapely. But in this caſe the new bone was neatly modelled, and provided with angular ridges and flat ſurfaces, ſo that it might very well paſs for the tibia of a perſon whoſe bone had been ſomewhat diſtorted from an attack of rickets. (Plate vii. fig. 1. exhibits a lateral view of this bone, and ſhows at once its angular ridges, flat ſurfaces, and incurvation.) Between A and B on the fore part, correſponding to the place of the cicatrix, there is a ſmall prominence, ſomewhat irregular at the edge; but this is the only

only deviation from the general regularity of ſhape.—Theſe are the chief circumſtances which require to be noticed in the external appearance of the bone; but the ſtructure of the internal parts ſtill remained to be examined. In thoſe caſes in which the ſequeſtra is excluded during the progreſs of the diſeaſe, the whole of the ſubſtitute bone is originally formed in one ſolid maſs, without any cavity or cancelli for the lodgment of marrow. Nor do I know of any diſſection on record, in which any ſuch regular ſtructure was found to have taken place at a period diſtant from the time of the attack. Mr. Ludwig, in the 3d volume of his Adverſaria, gives an account of a caſe nine years from the date of the cure, in which the ſubſtitute bone

was ſtill ſolid, without any appearance of a cavity in the centre. In the caſe now under conſideration, however, the bone, upon being ſawn through longitudinally, diſcovered a complete medullary canal, running the whole length of the bone, and to all appearance as perfect in every circumſtance as it could have been in the original bone. It extends without interruption from one end to the other, expands towards the extremities, and is full of cancelli. (See Plate vii. fig. 2.) Thus the new bone appears to have attained a wonderful degree of perfection in the organization of its ſtructure. It is modelled into a regular ſhape, provided with a perioſteum externally, and with a medullary cavity in the centre. So this preparation

tion removes every doubt reſpecting the ſtate which the ſubſtitute bone is ultimately capable of attaining, and, ſo far as I know, is the only inſtance of bone having been reproduced ſo perfect in all its parts.

CASE SECOND.

THE ſecond caſe was very different in the circumſtances of its hiſtory. It occurred in the perſon of a patient who ſuffered amputation above the knee. The ſtump, inſtead of healing kindly, was attacked with partial ſuppurations, which extended along the courſe of the femur, excited great pain, and protracted the cure. Small portions of bone had been at times thrown out from the extremity of the ſtump; and in about eight months from the date of the operation, a much larger portion was evidently looſe, and ready to come away.

It

It was eaſily removed, and after its removal a ſolid maſs of bone was ſtill found remaining behind, apparently of much larger dimenſions than what the femur of ſuch a perſon ought to be in its natural ſtate. It had a large cavity in its centre, and upon examination proved to be entirely a new formation. In ſhort, it had all the character of a ſubſtitute bone, ſuch as forms in an ordinary caſe of Necroſis. It was indeed formed under unuſual circumſtances, and upon this account afforded an opportunity to obtain the ſeparating portion of the original bone in a particular ſtate of decay. The length of this portion was about four and a half inches, (See Plate vii. fig. 4.), and compoſed one continuous maſs, which poſſeſſed a ſingular degree of conſiſtence for a bone. It was ſo friable

able as ſcarcely to bear its own weight without breaking, and accordingly, upon handling, it gave way at the point C. The greater part of the maſs conſiſted of a ſubſtance in the ſtate of powder, which poſſeſſed very little coheſion. It ſeemed to be the earthy portion of the bone almoſt entirely deprived of its connecting medium; and the converſion of it into this ſtate had proceeded ſo far, that the original bone was everywhere reduced to the ſtate of a thin ſhell, which gradually diminiſhed in thickneſs towards the farther extremity E, where there was ſcarcely a veſtige of the fabric of the original bone. In approaching towards the lower extremity of the bone A, which had been cut acroſs with the ſaw, the thickneſs and ſolidity of the ſhell increaſed. At B, a ſmall plate, ſimilar

milar to what ſo often ſeparates in the progreſs of a cure of Necroſis, was completely detached; and at D, there was nothing but a maſs of the powdery ſubſtance, cohering very ſlightly: and in all this neighbourhood, the ſurface was covered with nothing but thin and detached films of the original bone.—We may here trace ſome of the leading ſteps of the progreſs of the old bone towards decay. In the firſt place, it ſeems to be reduced to the ſtate of a powder, by the diſſolution of the uniting medium which connects the earthy particles together; and that when the earthy portion is thus looſened and detached, it is either taken into the ſyſtem by abſorption, or waſhed out through the apertures of the new bone along with the purulent matter. But there is no appearance that the

whole

whole ſubſtance of the bone is ever completely diſſolved into a fluid ſtate. It is a ſpecies of decompoſition which ſeems peculiar to a bone under particular circumſtances, and differs from the ordinary proceſs of putrefaction, both in the celerity with which it is accompliſhed, and in the abſence of fœtor.

THE END.